R&S®ZNA
VECTOR NETWORK ANALYZER

3 year warranty

Masters the most challenging measurement tasks

Product Brochure
Version 03.00

ROHDE&SCHWARZ
Make ideas real


ROHDE&SCHWARZ
ZNA - Vector Network Analyzer
Port 1
Port 3
Port 2
Port 4

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AT A GLANCE

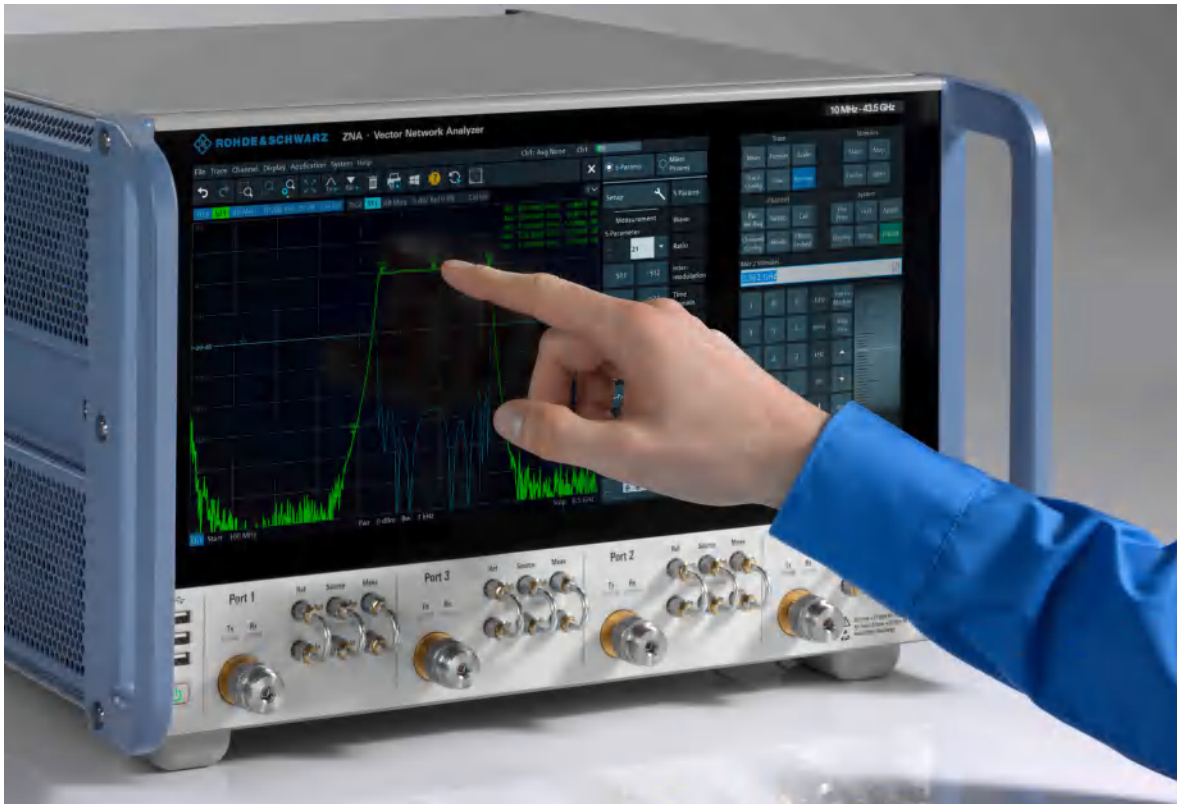
Offering outstanding RF characteristics and a unique hardware architecture, the R&S®ZNA high-end vector network analyzer makes demanding measurements easier than ever. Another exceptional feature is the analyzer's DUT-centric operating concept, which guides users quickly and conveniently to the desired measurement setup. Two independent touchscreens provide utmost flexibility for smooth, efficient operation.

The R&S®ZNA features exceptional stability, low trace noise and excellent raw data, making it a perfect choice for development and production applications that require high accuracy, e.g. for developing and producing components and modules for A&D and satellite applications.

The R&S®ZNA offers four internal, phase coherent sources, allowing independent control of the signal's frequency at each port as well as phase measurements on mixers. It provides two internal LO sources, a true multichannel receiver architecture, pulse generators and modulators, an internal combiner and comprehensive trigger and synchronization capabilities. These hardware features make the R&S®ZNA a universal, compact test system for active and passive device characterization. Even intermodulation measurements on mixers and receivers can be performed without external signal sources, minimizing test time and simplifying test configuration.

Thanks to the phase coherent digital sources and receivers, no reference mixers are needed for mixer phase measurements, and test setups are configured just as easily as for non-frequency-converting S-parameter measurements.

Users can operate the R&S®ZNA via two independent touchscreens.



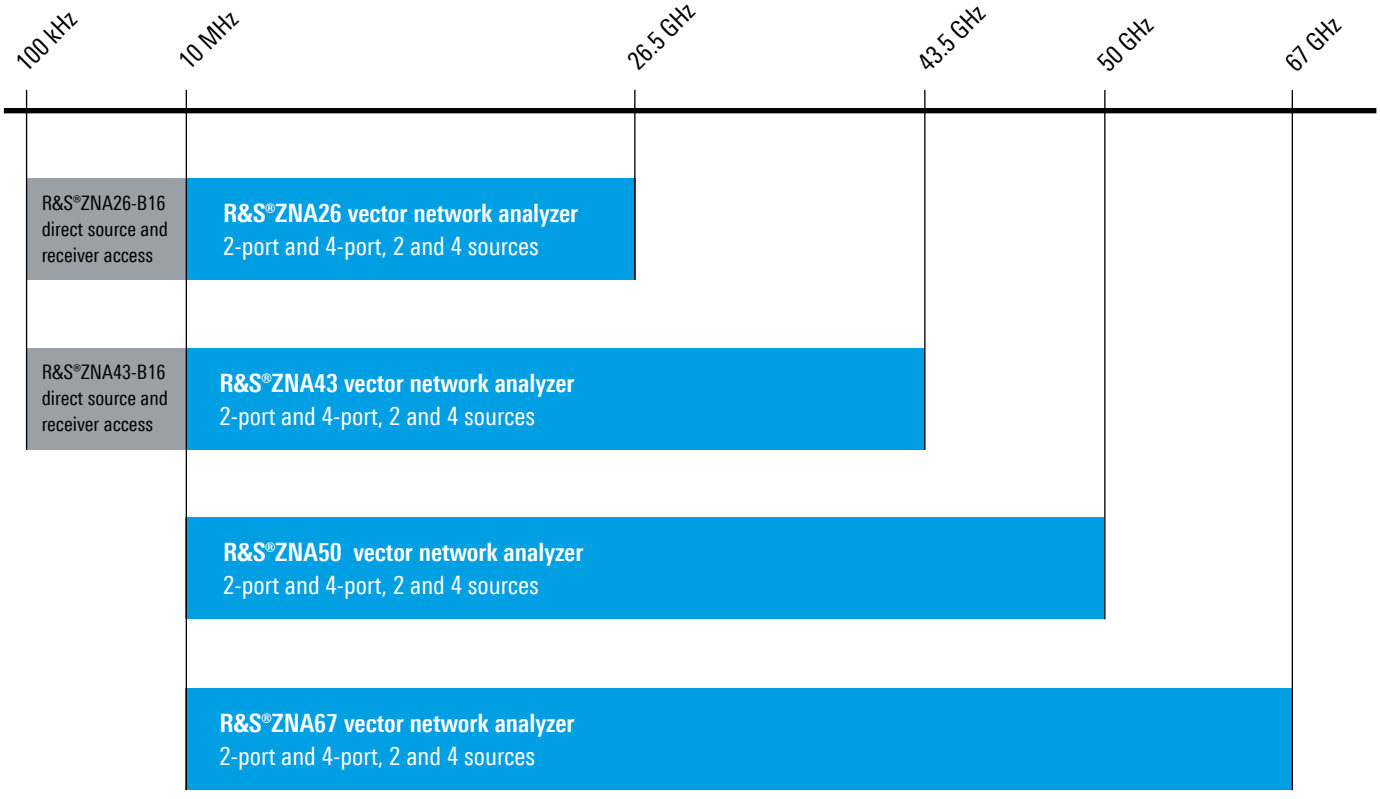
The analyzer's DUT-centric operating concept makes it possible to achieve the desired setup at an unrivaled speed. Users no longer need to work through a jungle of menus. Instead, a wizard guides them step by step through configuration and calibration. All relevant parameters are covered, and measurement traces are created in just a few steps.

The R&S®ZNA characterizes low-noise amplifiers (LNA), receivers, frequency-converting DUTs and transmit/receive (T/R) modules precisely and efficiently; the DUT needs to be connected only once.

The instrument provides numerous software applications, e.g. for intuitive configuration of group delay and spectrum measurements.

Various menu-based calibration procedures are available to help users calibrate even complicated setups efficiently and reliably. All the calibration methods supported by the R&S®ZNA can be expanded using a special calibration technique referred to as R&S®SMARTerCal. This technique combines system error correction with absolute power level correction, minimizing the number of calibration steps even with active DUTs, which involve considerable measurement effort.

R&S®ZNA models



KEY FACTS AND BENEFITS

Four internal phase coherent sources
- Compact multiple source setups
- Convenient phase measurements on mixers
- Phase coherent DUT stimulation and true differential measurements

Two internal LOs
- Excellent trace noise as low as 0.005 dB (spec.) and 0.002 dB (typ.) at 100 kHz IF bandwidth (IFBW)
- Fast mixer measurements
- More accurate phase results due to parallel signal sampling
- Rear panel LO output for mmWave systems and general purpose applications

Eight truly parallel measurement receivers
- Measurements on multipath DUTs and antenna arrays, use of analyzer as a powerful core in antenna test systems

Flexible signal routing and path access
- Internal combiner for intermodulation and embedded LO converter group delay measurements [1)]
- Reference signal access before or after source step attenuator for low trace noise even with very low stimulus signals (e.g. for high gain DUTs) [1)]
- Direct IF access for antenna test systems with external up/downconversion
- Rear panel LO output and direct IF input for compact mmWave test setups: 2/4-port mmWave converter setups with 2/4-port R&S®ZNA, without additional external source

Four internal pulse modulators
- Two-tone and bidirectional pulsed signal measurements

Phase measurements on mixers without reference mixers
- Simple mixer tests in a compact setup

Noise figure measurements on amplifiers and mixers
- Internal preamplifier (R&S®ZNA26-B302/ R&S®ZNA43-B302) for low-noise DUTs [1)]
- Quickset configuration dialog for fast and optimized amplifier noise figure measurements

Spectrum analysis option
- DUT characterization and spurious search without reconnecting the DUT to a spectrum analyzer

Group delay measurements on frequency converters with embedded LOs
- Reliable, straightforward satellite receiver measurements

High dynamic range
- Dynamic range of 139 dB (typ.) and up to 170 dB (typ., with options)
- Characterization of high-rejection filters
- Short test times and low trace noise

Wide power sweep range
- Power sweep range of 100 dB (typ.)
- Versatile compression measurements

Low trace noise
- Trace noise of < 0.001 dB (at 1 kHz IF bandwidth)
- Accurate, highly reproducible measurements

DUT-centric operating concept
- Easy startup, short configuration times

Compact instrument, quiet operation
- Acoustic noise as low as 42 dB(A)
- Small footprint, low noise pollution

[1)] R&S®ZNA26 and R&S®ZNA43 only.


ZNA · Vector Network Analyzer
Port 1
Ref
Source
Meas
Port 3

STATE-OF-THE-ART USER INTERFACE

Context-sensitive help

Menu bar
For operation with a mouse or finger

Undo/Redo
Cancels or restores the last operations

Toolbar
Frequently used functions such as zoom, new trace, new marker, print

More than 100 channels and traces
- ► Straightforward display of complex measurements
- ► Simultaneous, independent display of multiple test setups; display of large number of traces; arrangement of traces, channels and diagrams in any desired combination

Three front panel USB ports for connecting
- ► Storage media
- ► Keyboard and mouse
- ► Calibration units
- ► Power sensors

Direct source monitor access (option)
- ► Direct reference signal access before or after internal mechanical source step attenuator
- ► Low trace noise even with very small output power levels

12.1" touchscreen with state-of-the-art GUI

Softkeys and soft panel

- Logically structured menus: everything in view without scroll bar
- All parameters for a test setup presented in straightforward GUI dialogs
- Measured traces can be dragged and dropped

Touch panel

Instrument control and display of macros

Soft roll key with locking function

Status LEDs

Calibration status, remote operation, etc.

Direct source and receiver access (option)

Status LEDs for each port indicating

- TX/RX operation
- Input active

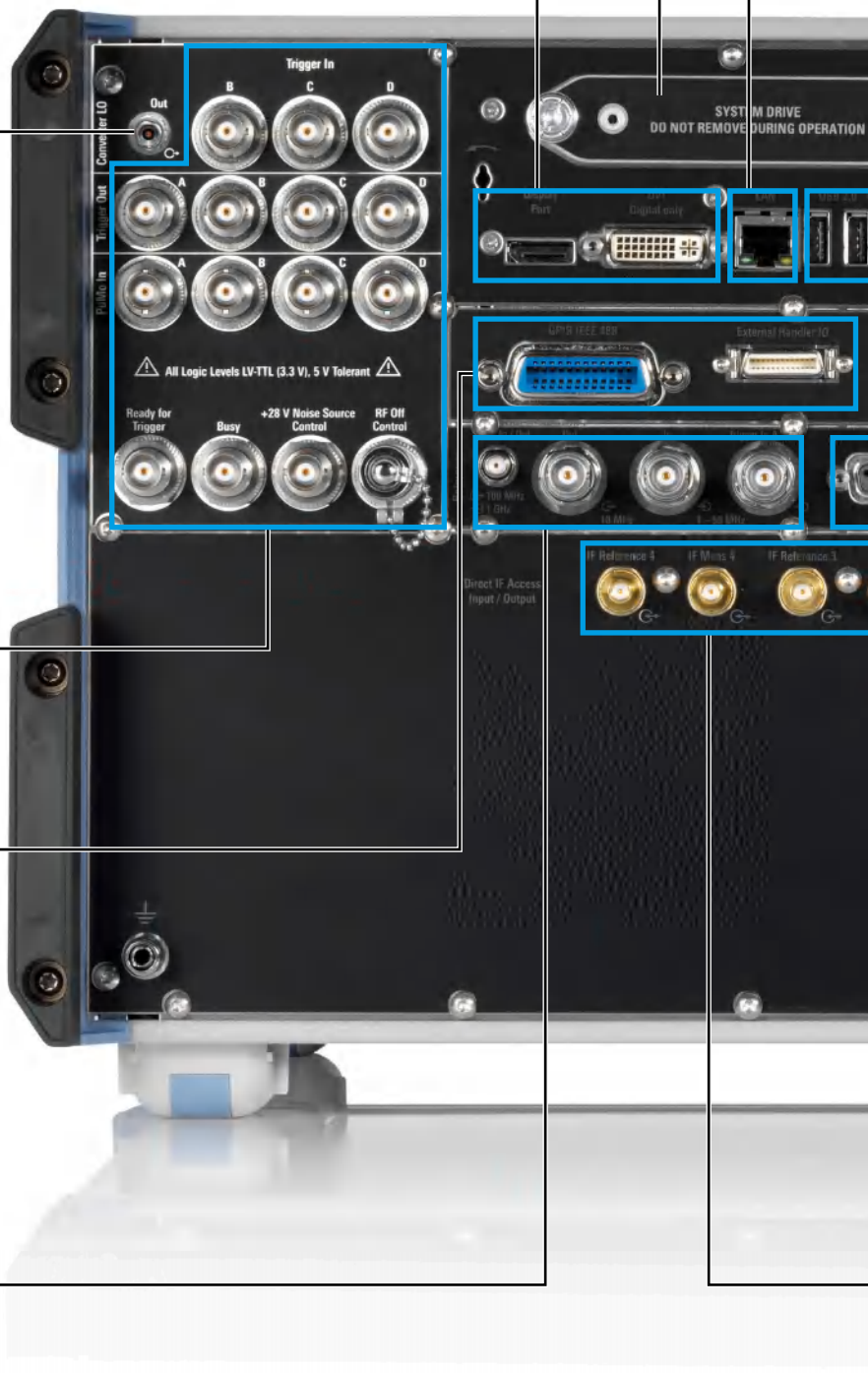
REAR PANEL CONNECTIONS

LAN port

SSD (removable)

Display ports
- DisplayPort
- DVI-D

Internal LO signal output (option)
- LO source for mmWave converter setups (standard internal LO or optional 2nd internal LO)
- General-purpose, configurable RF source up to 26.5 GHz (optional 2nd internal LO)



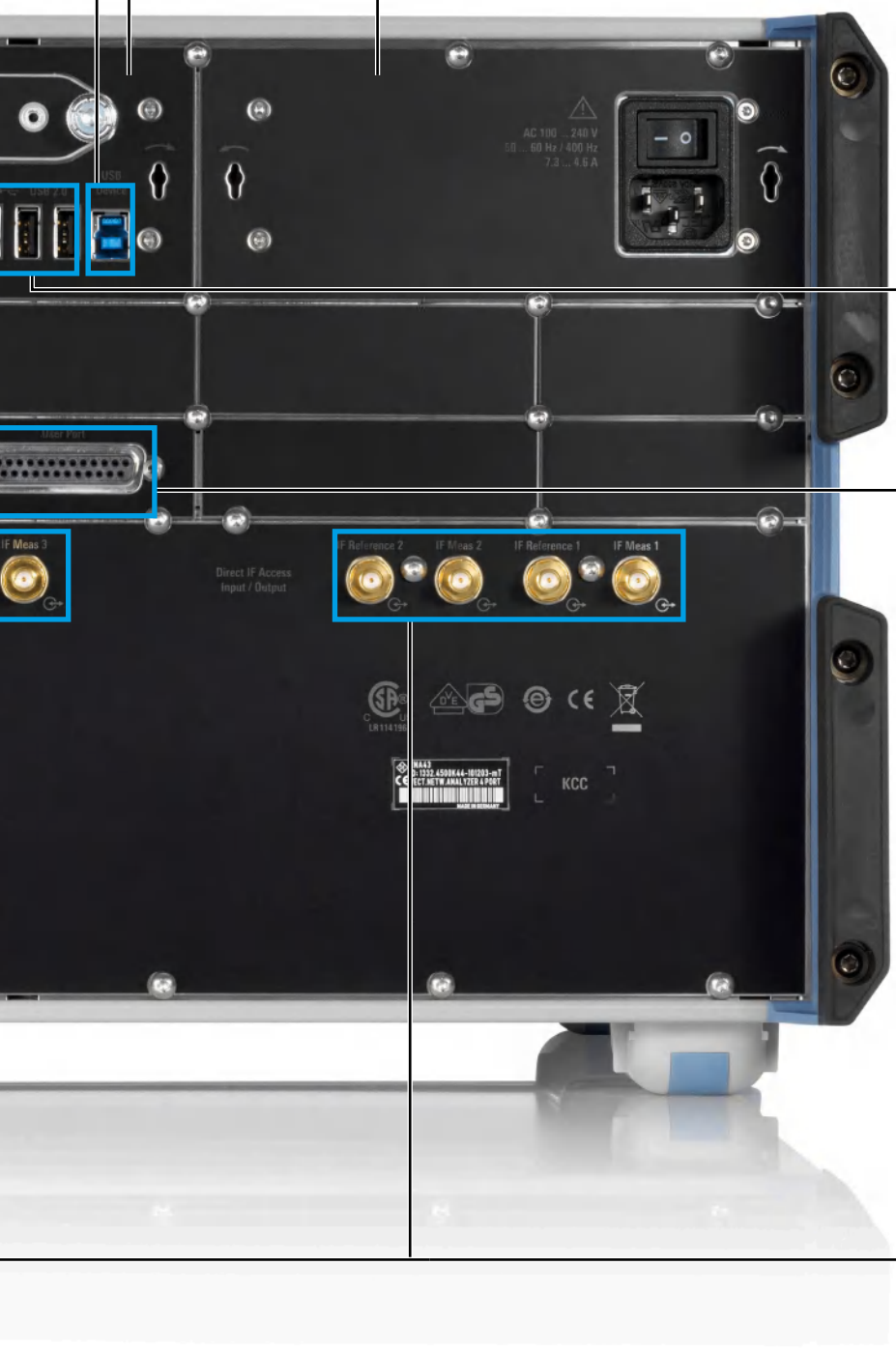
Trigger board (option)
- Three additional trigger inputs
- Four trigger outputs
- Four connectors for pulse modulator control
- Ready for trigger (output)
- Busy (output)
- RF interlock control (input)

GPIB port

Standard control and sync connectors
- Reference frequency output: 10 MHz, 100 MHz
- Reference frequency input: 1 MHz to 50 MHz, 100 MHz, 1 GHz
- Trigger input

USB control
For remote device control via USB

Modular design for easy maintenance
Control PC and power supply



Four USB ports (default: 2.0) for connecting
- Storage media
- Keyboard and mouse
- Calibration units
- Power sensors

User port
- Digital I/Os
- Power supply

Direct IF access (option)
- I/Os (input/output switchable; IF bandwidth, output: 2 GHz IF bandwidth, input: 1 GHz)
- Access to measurement and reference receiver IF of each port

UNIQUE OPERATING CONCEPT WITH TWO TOUCHSCREENS

Operation using touch gestures

Users can operate the R&S®ZNA via two independent touchscreens:

- Innovative control panel on the right instead of mechanical keys which can wear out over time
- 12.1" touch display on the left for configuring and displaying measurements

The dual-screen operating concept offers utmost flexibility in configuring measurements. Touch gestures are used to zoom, move traces and add markers. Traces, channels and diagrams can be dragged and dropped to arrange them in any desired combination. The control panel on the right can, among other things, be used to display macros, remote control commands and auxiliary tools.

Analyzer operation is intuitive, which significantly shortens the learning curve and delivers results very quickly. The user can choose between conventional and guided approaches to configuration.

Three alternatives to arrive at the desired setup

1. Conventional approach

Users can take the conventional approach to configure measurements on the R&S®ZNA. From various menus, they can select the parameters for a desired setup, e.g. power parameters, the number of points, and the measurement type and measurement quantity. However, complex test setups, e.g. for mixer or intermodulation measurements, require a vast number of parameters to be set carefully. Working one's way through a host of menus is time-consuming and error-prone, and the user may find it difficult to keep track of the overall configuration. To enable users to configure even complex measurement tasks quickly and accurately, covering all the required parameters, the R&S®ZNA offers two alternatives.

2. All-in-one dialogs – keeping track even of sophisticated setups

All-in-one dialogs for typical measurements such as intermodulation on mixers combine, in a single display, all key parameters otherwise distributed among several menus. The hardware is configured interactively using graphic elements. Test parameters such as frequencies, power levels and bandwidths are set via pull-down menus and input fields. Users see all relevant information at a glance, not missing a single parameter. Measurement traces for any desired measurement quantities can then be dragged and dropped to any desired position.

3. Step by step to the desired setup: the DUT-centric wizard

Another alternative is a step-by-step, DUT-centric approach. In a first step, the user defines the type of DUT (e.g. mixer) and its key data (e.g. maximum/minimum input power level and frequency ranges). This data can be saved. The wizard then prompts the user, in easy-to-follow steps, to define the required settings und measurement parameters, using DUT-specific terms (e.g. "Conversion Gain RF to IF" or "Feedthrough LO to IF").

Zoom function

Users can zoom with a simple finger gesture or by dragging the mouse.
The background color of the screen can be configured as desired.

Control of the R&S®ZNA via touch panel. Users benefit from all-in-one dialogs, which provide a clear overview of all key parameters and help to keep track of the overall measurement configuration.

Users can configure measurement tasks conveniently with touch gestures.

After all the required settings have been made, the analyzer automatically creates and displays the associated channels and traces. If desired, the user can complete the measurement configuration by adding system error correction, which is likewise executed step by step.

Trace analysis functions

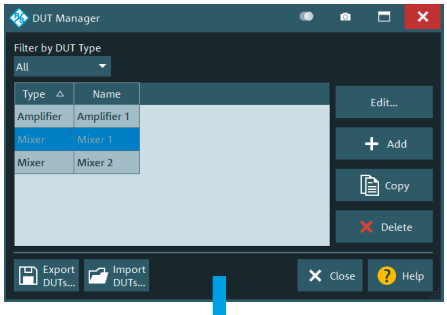
A wide variety of trace analysis functions provide a clear overview of key parameters:

- Ten markers per trace, including analysis functions and conversion to desired unit
- Automatic bandwidth measurement on filters
- Limit and ripple check with configurable pass/fail indication
- Statistical trace analysis including maximum, minimum, RMS, peak-to-peak and compression point
- Equation editor for complex trace mathematics

Fast switching between instrument setups

With the R&S®ZNA, multiple setups can be kept in memory simultaneously, allowing users to switch quickly between measurement tasks. This feature is especially advantageous with DUTs that deliver a variety of complex results, as it provides a quick overview and simplifies operation.

DUT-centric measurement configuration



Based on the DUT type, the user is prompted to select and configure the desired measurements in a step-by-step process. The required channels and traces, e.g. for measuring LO feedthrough, are automatically created.

The R&S®ZNA comes with an extensive range of hardware options.

TOP-CLASS HARDWARE COMPONENTS

The R&S®ZNA comes with an extensive range of hardware options, allowing customized configuration for the intended use.

Four internal sources [1)]

The R&S®ZNA is available with up to four internal sources (R&S®ZNAxx-B3 option, 3rd and 4th internal source for 4-port models). The user benefits from a powerful, compact system that can even perform intermodulation measurements on mixers and receivers with two converter stages. The digitally controlled, phase coherent and phase repeatable sources allow phase measurements on mixers and converters without external reference mixers.

Direct IF access [1)]

When used as inputs, the R&S®ZNA-B26 direct IF access ports provide direct access to the internal IF signal paths. The IF frequency is selectable with 1 GHz bandwidth, which provides a high degree of freedom for system integration, especially when integrating the analyzer into antenna test systems with external mixers. When used as outputs, the R&S®ZNA-B26 ports make it possible to record and analyze data using external equipment. In that case, 2 GHz of bandwidth is available.

Synchronization and trigger capabilities [1)]

The R&S®ZNA offers a comprehensive range of synchronization and trigger features such as diverse trigger inputs and outputs, e.g. for test status indication, definition of criteria for logical decision-making, RF power shutdown, flexible test sequence control in pulsed measurements, synchronization of external devices, and for timing control during test sequences in production. The R&S®ZNA-B91 option (trigger and control I/O board) acts as an interface for the input and output of signals.

Second internal LO source and mmWave converter LO output [1)]

The second internal LO source (R&S®ZNA-B5 option, for 4-port models) allows two ports to receive signals at different frequencies. This means that two frequencies can be measured simultaneously, e.g. the RF and the IF signal of a mixer, making the measurement twice as fast and reducing trace noise. The optional R&S®ZNA-B8 mmWave converter LO output makes the analyzer's internal LO signal (standard LO or second internal LO from 10 MHz to 26.5 GHz) available on the rear panel, e.g. for feeding mmWave converters connected to the R&S®ZNA [2)]. Alternatively, the second LO can be used as a general-purpose RF source, e.g. for external mixers.

Four internal pulse generators and four internal pulse modulators [1)]

Four pulse generators and modulators make it possible to generate pulsed two-tone signals and bidirectional pulsed signals, e.g. for intermodulation measurements on T/R modules. The pulse generators are enabled with any of the following options: R&S®ZNAxx-B4n (internal pulse modulator for port n) and R&S®ZNA-B91 (trigger and control I/O board). This means that e.g. the trigger and control I/O board alone enables use of the internal pulse generators to control internal or external pulse modulators (e.g. to generate pulses with a duration of < 40 ns). Point-in-pulse measurements are delivered by the base unit; pulse profile measurements are added with the R&S®ZNA-K7 option.

[1)] All R&S®ZNA models (R&S®ZNA26, R&S®ZNA43, R&S®ZNA50 and R&S®ZNA67).
[2)] Configuration of the R&S®ZNA-B8 output for use with mmWave converters requires the R&S®ZNA-K8 option (mmWave converter support).

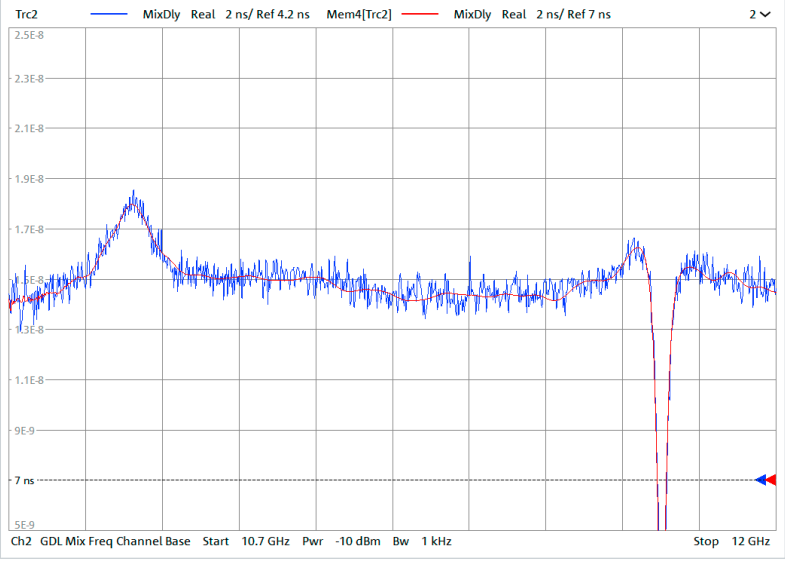
Internal combiner [1]

A switchable internal combiner (R&S®ZNA26-B213/ R&S®ZNA43-B213) combines the signals from ports 1 and 3 to provide a two-tone signal at port 1, enabling intermodulation measurements and embedded LO group delay measurements (with R&S®ZNA-K9 option) to be carried out without additional external equipment.

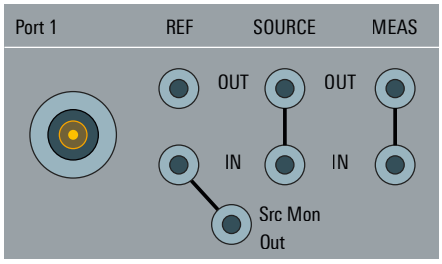
Direct source and receiver access [2], source monitor (reference signal) access [1] before or after source step attenuator

The R&S®ZNAxx-B16 direct source and receiver access option [2] provides direct access to the source and receiver paths. On the one hand, this yields highest sensitivity as the internal coupler can be bypassed, thus avoiding the coupler attenuation, on the other hand, it supports e.g. external high-power test setups. Testing at low stimulus levels is further improved with the R&S®ZNA26-B501/ R&S®ZNA43-B501 low-power spurious reduction option [1]. An isolation amplifier provides optimized spurious reduction, delivering excellent signal purity for power levels down to –110 dBm and below.

The R&S®ZNA26-B161/-B163 and R&S®ZNA43-B161/-B163 direct source monitor access options [1] make the R&S®ZNA even more versatile. They provide direct access to the reference signal, i.e. they allow the reference signal to be picked up before the internal source step attenuator. With the step attenuator set to high attenuation for very small output power levels, picking up the reference signal before the source step attenuator will provide a reference signal strong enough to deliver low-noise traces, thus providing high accuracy even with high gain DUTs such as satellite and radar modules.



Group delay measurement on a 60 dB gain embedded LO converter (IFBW = 10 kHz for both measurements).
Blue trace: poor trace noise with the low-level reference signal picked up after the source step attenuator.
Red trace: minimized trace noise with the reference signal picked up before the source step attenuator, yielding a high signal-to-noise ratio at the reference receiver.



R&S®ZNAxx-B16 front panel jumper position required for direct source monitor access (R&S®ZNA26-B161/ -B163 and R&S®ZNA43-B161/-B163 options).

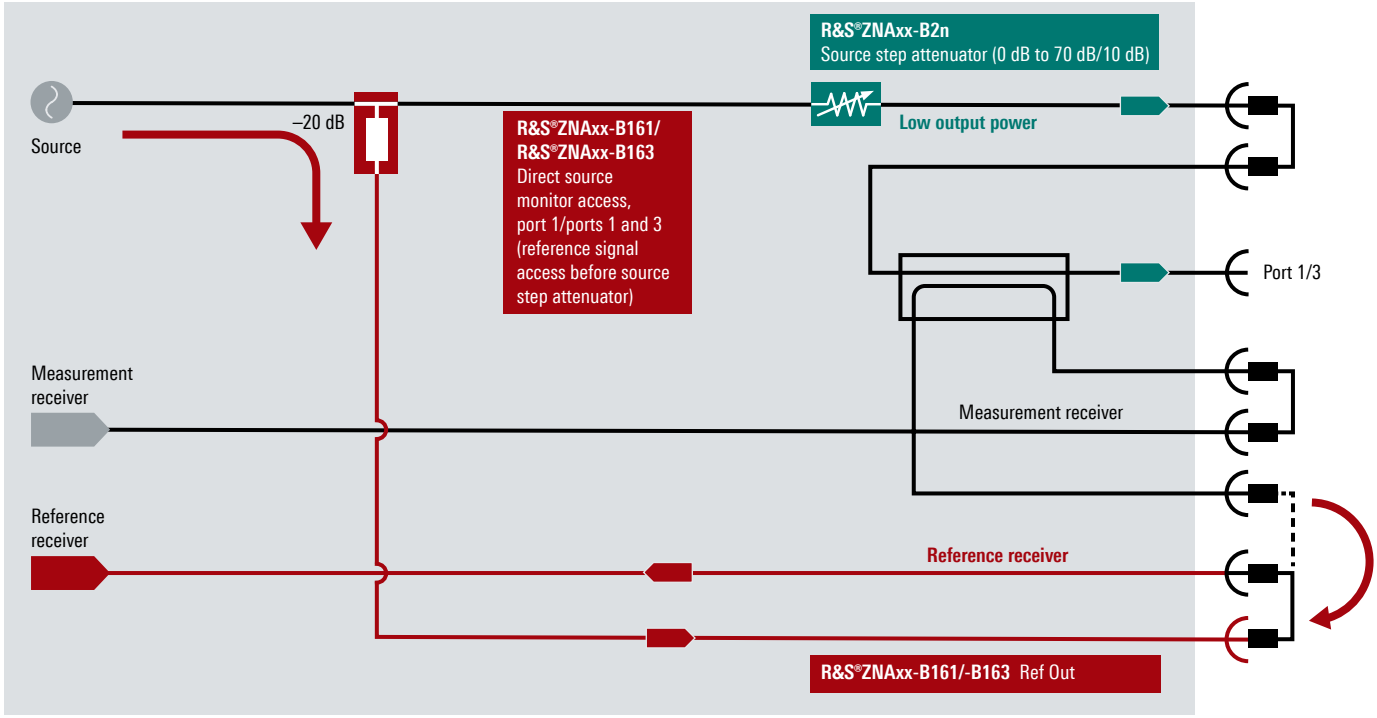
Internal preamplifier supports noise figure measurements

The R&S®ZNA26-B302/R&S®ZNA43-B302 option [1] is a switchable low-noise amplifier (LNA) inserted upstream of the port 2 measurement receiver. With selectable gain up to 30 dB, even low gain/low noise figure DUTs can be accurately characterized.

[1] R&S®ZNA26 and R&S®ZNA43 only.
[2] All R&S®ZNA models (R&S®ZNA26, R&S®ZNA43, R&S®ZNA50 and R&S®ZNA67).

R&S®ZNA26-B161/-B163 and R&S®ZNA43-B161/-B163 options [1]

When the R&S®ZNA26-B16/R&S®ZNA43-B16 reference signal front panel jumper (ports 1 and 3) is reconnected from the standard position (Ref Out) to the direct source monitor output (R&S®ZNA26-B161/-B163, R&S®ZNA43-B161/-B163), the reference signal will be picked up before the source step attenuator.



UNPRECEDENTED RF QUALITY

Wide dynamic and power sweep range

The very high dynamic range of the R&S®ZNA allows the characterization of high-rejection filters. With high output powers and a wide power sweep range, the instrument can analyze the large- and small-signal behavior of amplifiers in a single sweep:

- Dynamic range: 147 dB (typ.)[1], > 129 dB (specified, without options)
- Maximum attainable dynamic range: 170 dB (typ.)[2]
- Electronically controlled power sweep range up to 100 dB (typ.), interruption-free up to 40 dB (typ.)

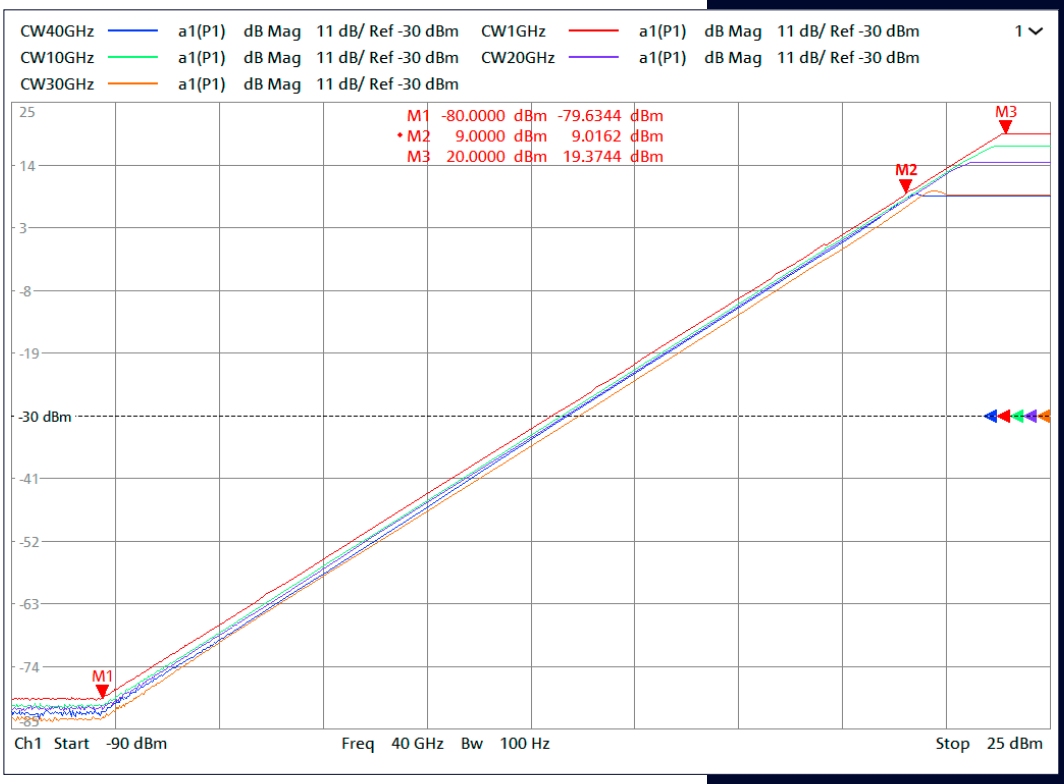
[1] With R&S®ZNAxx-B3n option.

[2] Requires: maximum output power, R&S®ZNAxx-B16 option, R&S®ZNAxx-B3n option, reversed coupler configuration at receive port, and 1 Hz IF bandwidth.

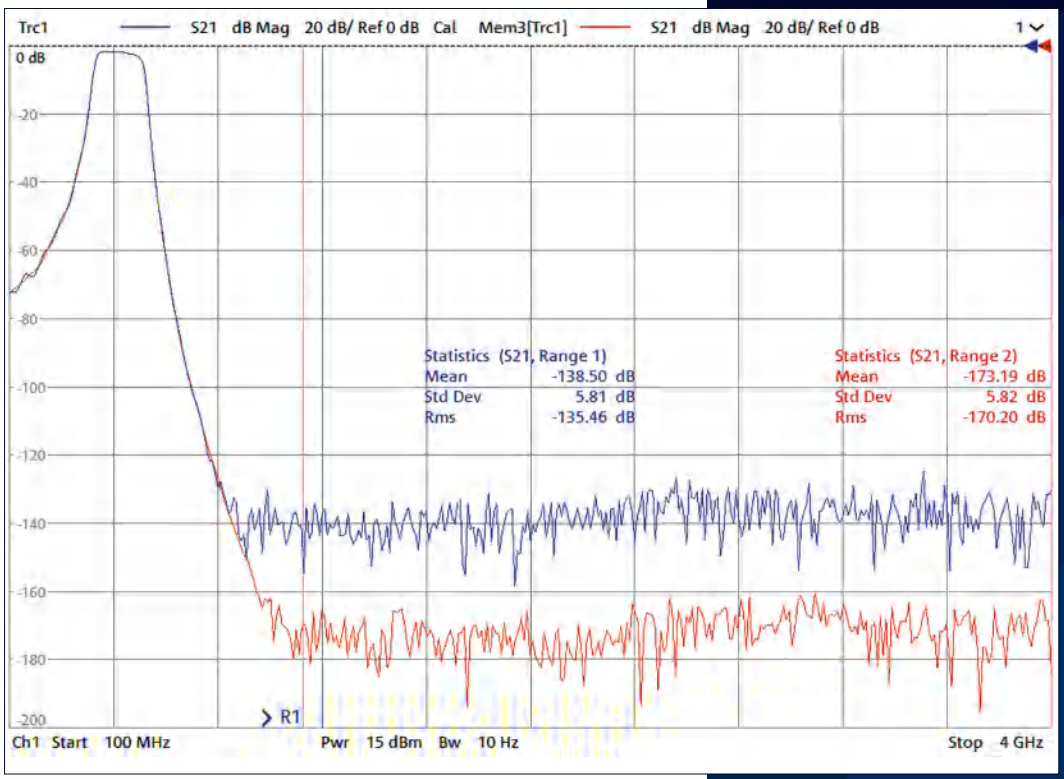
High stability for reliable results

The R&S®ZNA test set and receivers feature excellent temperature and long-term stability. The instrument's magnitude and phase drift are very low, with values of < 0.01 dB/K and < 0.1°/K (typ.). A calibrated R&S®ZNA delivers precise measurements over several days without recalibration:

- Trace noise of 0.001 dB (RMS, at 1 kHz IF bandwidth)
- Temperature stability of 0.01 dB/K and 0.1°/K
- Reliable measurement of high power levels thanks to 0.1 dB receiver compression for 10 dBm power level at test port
- High dynamic range of sources due to source step attenuators up to 70 dB and electronic power sweep range up to 100 dB
- Excellent receiver linearity of < 0.05 dB across an extremely wide range of –50 dBm to +8 dBm



Maximum power sweep range of up to 100 dB.



Dynamic range: at maximum specified output power,
without options (blue trace: at 10 Hz IF bandwidth);
at maximum specified output power, in reversed coupler mode,
with receiver step attenuator set to 0 dB (red trace: at 1 Hz IF bandwidth).

HARDWARE OPTIONS

Description	Applications and benefits	Hardware option
Direct source and receiver access [1] ► With start frequency down to 100 kHz [2] ► Supports reversed coupler configuration	► Facilitates external test setups for power measurements across a wide frequency range ► Reversed coupler configuration increases dynamic range and reduces system noise figure	R&S®ZNAxx-B16 [3] [4]
R&S®ZNA 4-port model with up to four internal sources	► Short measurement times ► Flexible-to-configure, compact test setups, e.g. for DUTs with two converter stages	R&S®ZNAxx-B3n [3] [4] [5]
2nd internal LO source ► For simultaneous measurement of two different frequencies (e.g. RF and IF signal of mixers) ► Additional RF source (in combination with R&S®ZNA-B8 mmWave converter LO output)	► Fast mixer and converter measurements ► Very low trace noise with frequency-converting measurements ► General-purpose RF source up to 26.5 GHz (e.g. to provide LO signal for external mixers)	R&S®ZNA-B5 [4]
Four/eight true receivers (no multiplexing)	► Reliable multichannel phase and antenna measurements	Provided as standard in base unit [4]
Direct IF access, I/O ports switchable as inputs or outputs, with 2 GHz analog IF bandwidth (output) and 1 GHz analog IF bandwidth (input)	Enhanced flexibility and sensitivity, e.g. when used in antenna test systems ► Provides direct access to up to eight phase coherent receivers ► Supports compact mmWave converter setups	R&S®ZNA-B26 [4]
Four internal pulse generators and four internal pulse modulators	► For measurements on pulsed signals and for flexible system integration ► R&S®ZNA-B7 increases the number of wave quantities that can be captured in parallel with R&S®ZNA-K7	R&S®ZNA-K7 [4], R&S®ZNAxx-B4n [3] [4] [6], R&S ZNA-B7 [4]
Enhanced trigger and control functions (three additional trigger inputs, four trigger outputs, four pulse control I/O ports, ready for trigger, busy, RF interlock control) [7]	► Universal system adaptation and easy system integration ► High reference frequency for low phase noise	R&S®ZNA-B91 [4]
Source step attenuators, 0 dB to 70 dB in 10 dB steps	► Generation of low-power stimulus signals down to –110 dBm	R&S®ZNAxx-B2n [3] [4] [6]

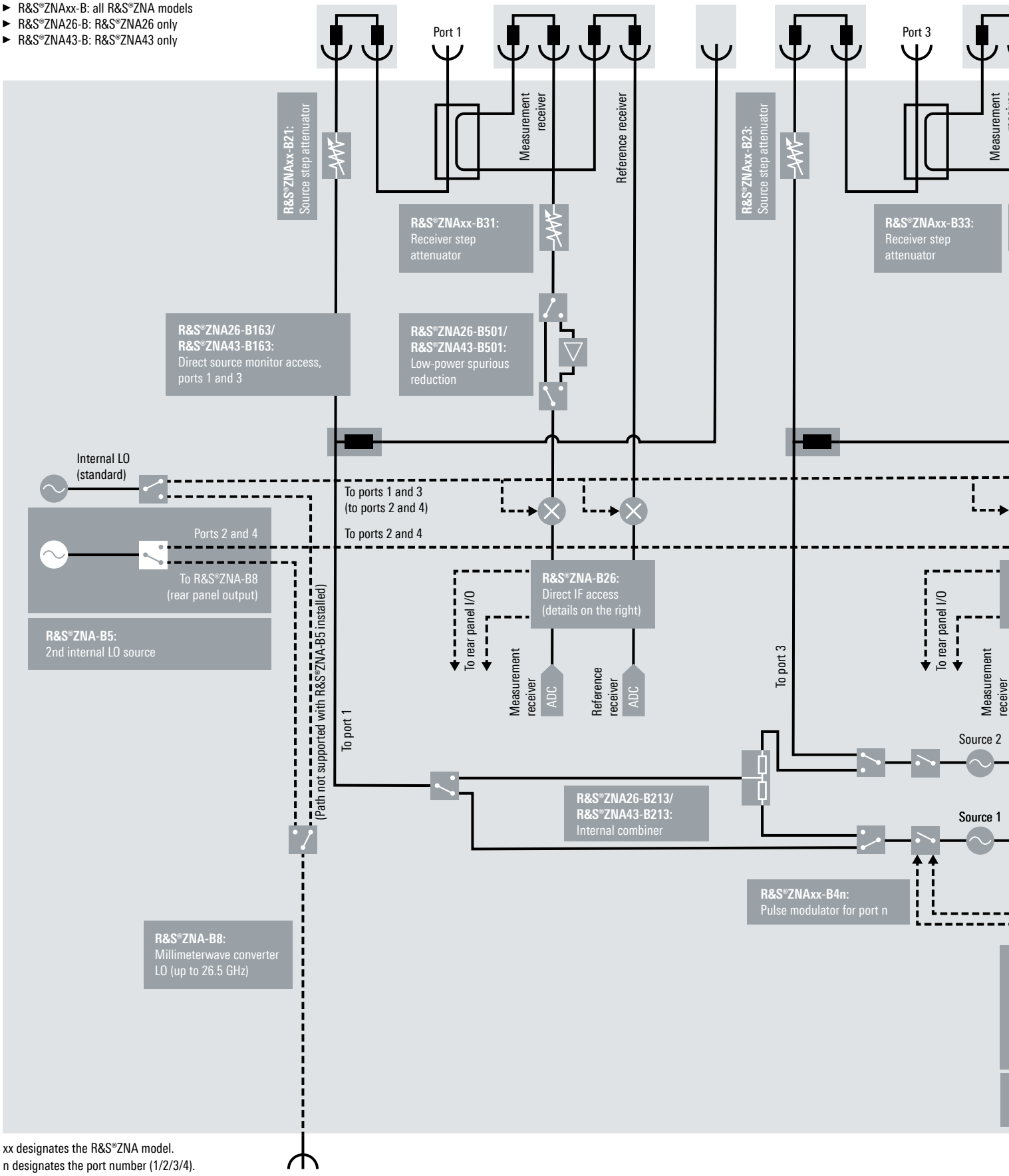
Description	Applications and benefits	Hardware option
Receiver step attenuators, 0 dB to 35 dB in 5 dB steps	► Compression-free measurements with input power up to destruction limit of +27 dBm	R&S®ZNAxx-B3n[3) 4) 6)]
Rear panel output for internal LO signal (when 2nd internal LO source (R&S®ZNA-B5) is installed, the 2nd LO source is made available at the output); provides up to +25 dBm output power	► Support of compact mmWave converter setups (2/4-port mmWave converter setups with 2/4-port R&S®ZNA) without additional external source ► General-purpose RF source up to 26.5 GHz ► High source power not affected by hardware options installed in the R&S®ZNA frontend	R&S®ZNA-B8[4)]
Switchable internal combiner, provides a two-tone signal at port 1[8)]	► Intermodulation measurements ► Embedded LO converter group delay measurements (R&S®ZNA-K9 option)	R&S®ZNA26-B213, R&S®ZNA43-B213[2)]
Direct source monitor (reference signal) access; when reconnecting the R&S®ZNAxx-B16[3) 4)] reference signal front panel jumper to the direct source monitor output (R&S®ZNA26-B161/-B163, R&S®ZNA43-B161/-B163)[2)], the signal to the reference receiver can be picked up before the source step attenuator	► Low trace noise even with low output power levels as typically encountered with high gain DUTs ► Monitoring of source output power simultaneously at source monitor output and test port	R&S®ZNA26-B161/-B163, R&S®ZNA43-B161/-B163[2)]
Low-noise preamplifier at port 2 measurement receiver, switchable low-noise amplifier (LNA) with selectable gain and integrated filter[9)]	► Noise figure measurements on amplifiers and converters ► Up to 30 dB gain for low gain/low noise figure DUTs	R&S®ZNA26-B302, R&S®ZNA43-B302[2)]
Low-power spurious reduction, isolation amplifier at port 1 measurement receiver; low-power spurious level is reduced down to –110 dBm	► Optimized spurious suppression ► Signal purity with very low stimulus levels ► Reliable high gain amplifier/converter testing	R&S®ZNA26-B501, R&S®ZNA43-B501[2)]

1) Between 100 kHz and 10 MHz, the internal coupler can only be used to a limited extent. Here, external directional components and recalibration are required.
2) R&S®ZNA26 and R&S®ZNA43 only.
3) xx designates the R&S®ZNA model (R&S®ZNA26, R&S®ZNA43, R&S®ZNA50 and R&S®ZNA67).
4) All R&S®ZNA models (R&S®ZNA26, R&S®ZNA43, R&S®ZNA50 and R&S®ZNA67).
5) The 2-port R&S®ZNA models come with one RF source as standard, the 4-port R&S®ZNA models with two RF sources.
6) n designates the port number (1/2/3/4).
7) 1 GHz reference frequency input provided as standard.
8) 4-port R&S®ZNA only.
9) Up to 40 GHz.

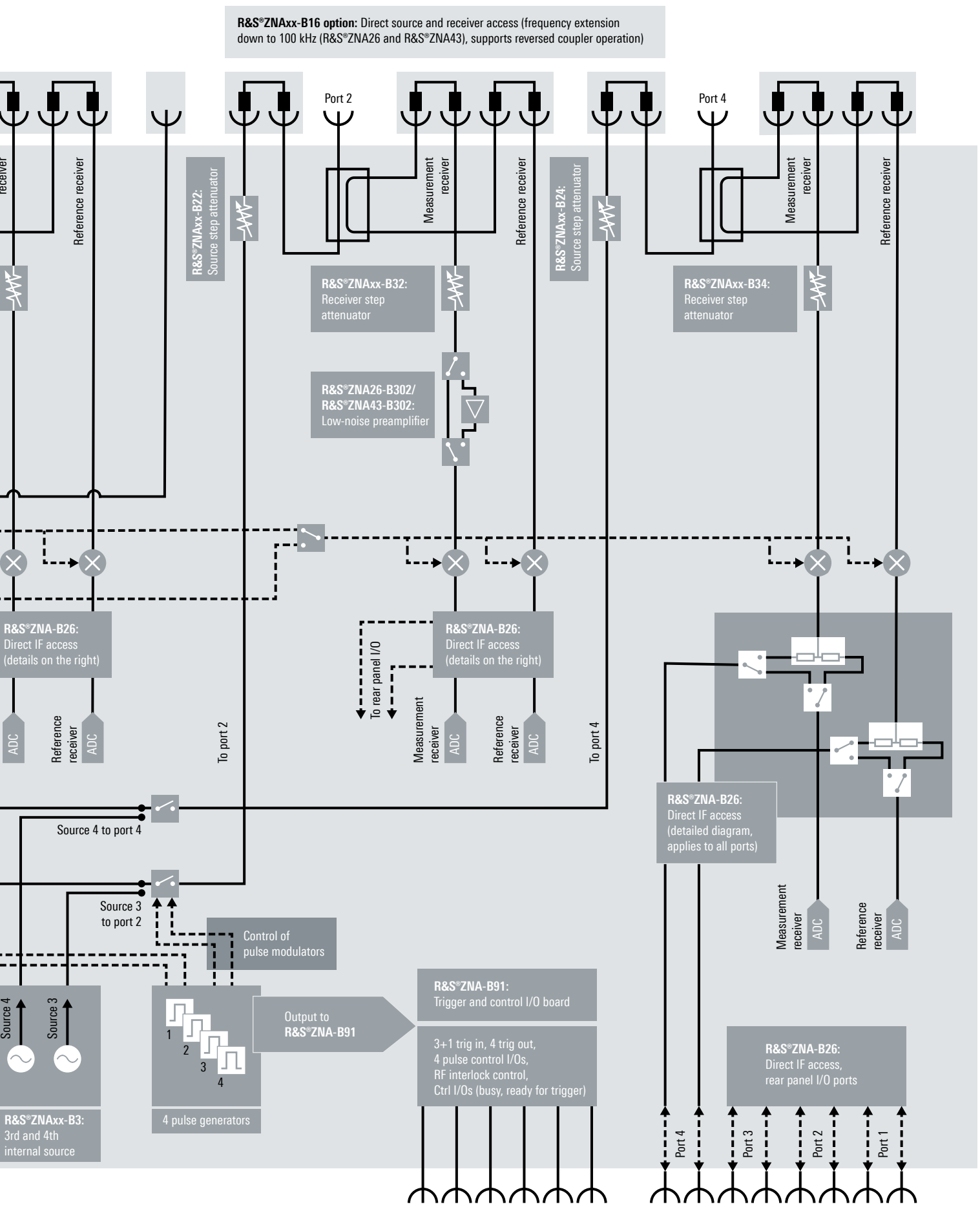
PRINCIPLE OF OPERATION OF 4-PORT R&S®ZNA

Option availability

- R&S®ZNA-B: all R&S®ZNA models
- R&S®ZNAxx-B: all R&S®ZNA models
- R&S®ZNA26-B: R&S®ZNA26 only
- R&S®ZNA43-B: R&S®ZNA43 only



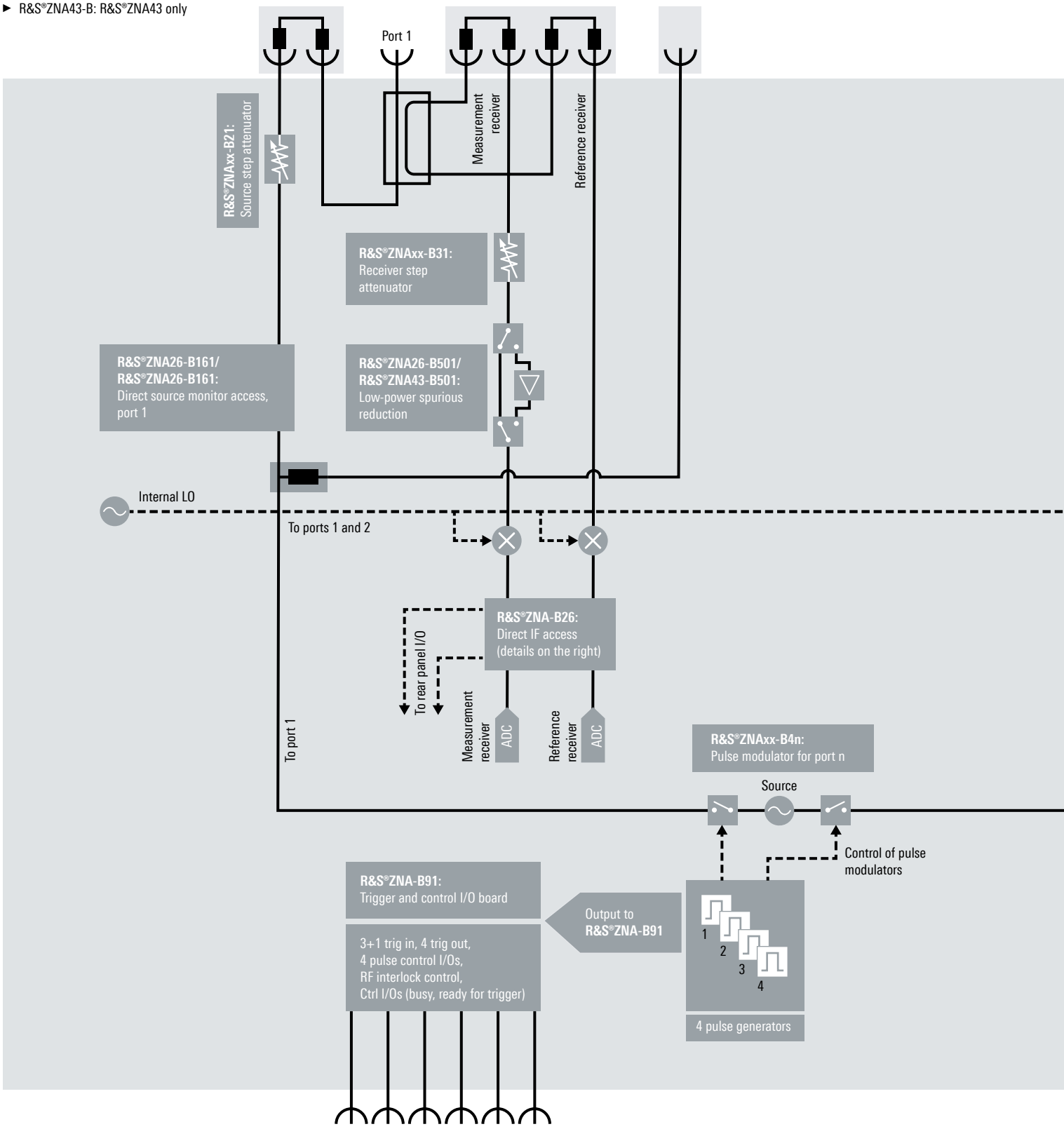
xx designates the R&S®ZNA model.
n designates the port number (1/2/3/4).


R&S®ZNAxx-B16 option: Direct source and receiver access (frequency extension down to 100 kHz (R&S®ZNA26 and R&S®ZNA43), supports reversed coupler operation)
Port 2
Port 4
Reference receiver
Measurement receiver
R&S®ZNAxx-B22: Source step attenuator
R&S®ZNAxx-B24: Source step attenuator
R&S®ZNAxx-B32: Receiver step attenuator
R&S®ZNAxx-B34: Receiver step attenuator
R&S®ZNA26-B302/ R&S®ZNA43-B302: Low-noise preamplifier
R&S®ZNA-B26: Direct IF access (details on the right)
To rear panel I/O
ADC
To port 2
To port 4
Source 4 to port 4
Source 3 to port 2
Control of pulse modulators
Source 4
Source 3
1
2
3
4
4 pulse generators
Output to R&S®ZNA-B91
R&S®ZNA-B91: Trigger and control I/O board
3+1 trig in, 4 trig out, 4 pulse control I/Os, RF interlock control, Ctrl I/Os (busy, ready for trigger)
R&S®ZNAxx-B3: 3rd and 4th internal source
R&S®ZNA-B26: Direct IF access (detailed diagram, applies to all ports)
R&S®ZNA-B26: Direct IF access, rear panel I/O ports
Port 1
Port 3

PRINCIPLE OF OPERATION OF 2-PORT R&S®ZNA

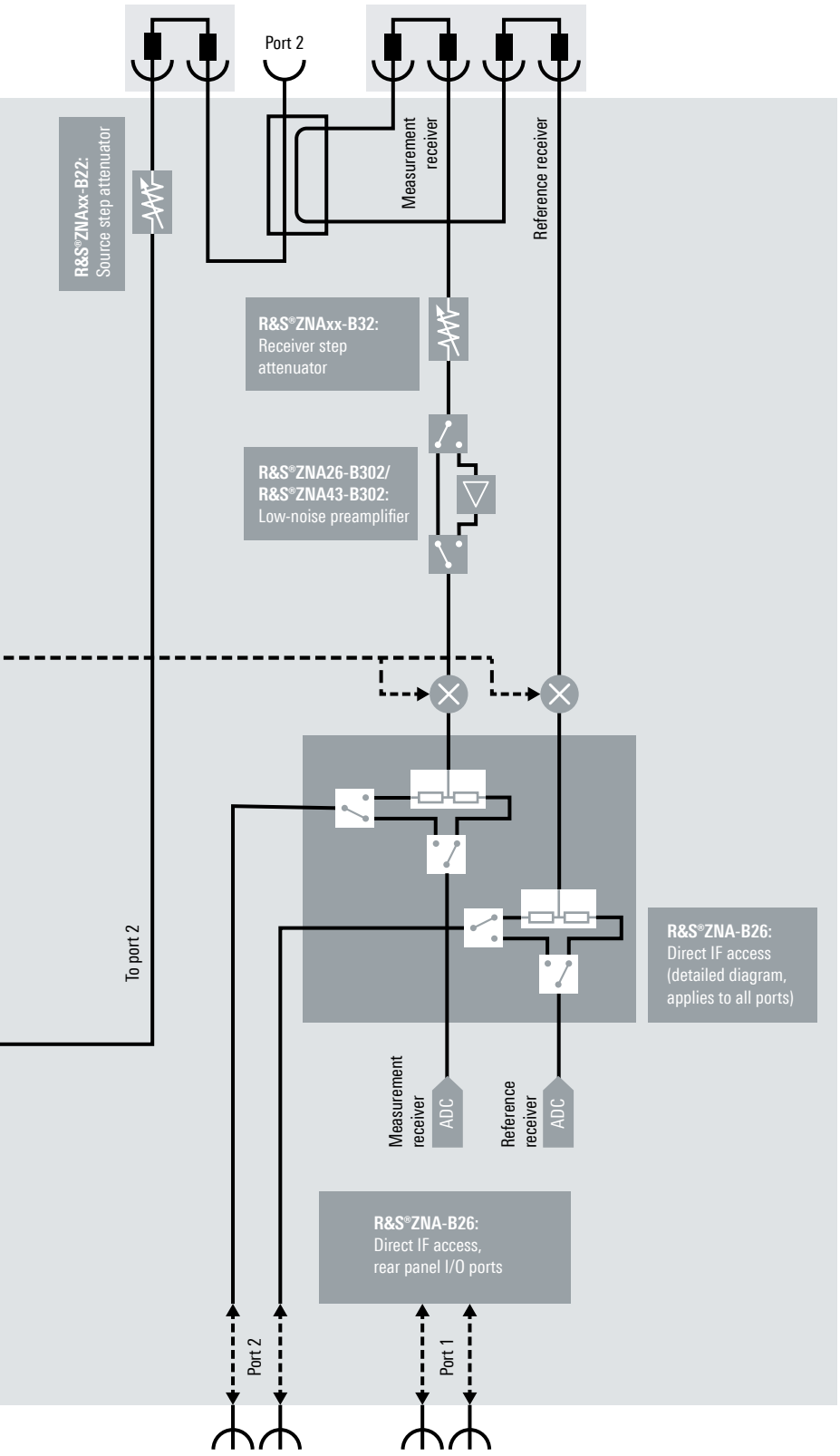
Option availability

- R&S®ZNA-B: all R&S®ZNA models
- R&S®ZNAxx-B: all R&S®ZNA models
- R&S®ZNA26-B: R&S®ZNA26 only
- R&S®ZNA43-B: R&S®ZNA43 only



xx designates the R&S®ZNA model.
n designates the port number (1/2).

R&S®ZNAxx-B16 option: Direct source and receiver access (frequency extension down to 100 kHz (R&S®ZNA26 and R&S®ZNA43), supports reversed coupler operation)



THE RIGHT CALIBRATION FOR EVERY TEST SCENARIO

The R&S®ZNA offers classic through, open, short, match (TOSM) calibration, which provides a maximum of precision for S-parameter measurements especially in coaxial test environments. The R&S®ZNA also supports calibration methods for DUTs in other, specific test environments, e.g. in test fixtures or on wafers, and for DUTs equipped with different types of connectors at the input and output.

Full calibration with only three standards – faster, simpler, more precise

- Through, reflect, line/line, reflect, line (TRL/LRL) for on-wafer applications, waveguides and coaxial DUTs
- Through, reflect, match (TRM) for applications in test fixtures and on wafers
- Through, short, match (TSM) and through, open, match (TOM) as alternatives to TOSM, for reduced calibration effort

Calibration for DUTs using a mix of connectors

The classic TOSM method does not provide direct calibration of test setups for DUTs equipped with different types of connectors at the input and output. The R&S®ZNA offers two alternatives to provide this type of calibration.

UOSM calibration

Unknown through, open, short, match (UOSM) calibration is the smartest way to overcome the above problem. It involves about the same effort as TOSM calibration. A through connection with unknown parameters is required, i.e. a reciprocal (but otherwise more or less arbitrary) two-port, e.g. a simple and cost-effective adapter.

Adapter removal method

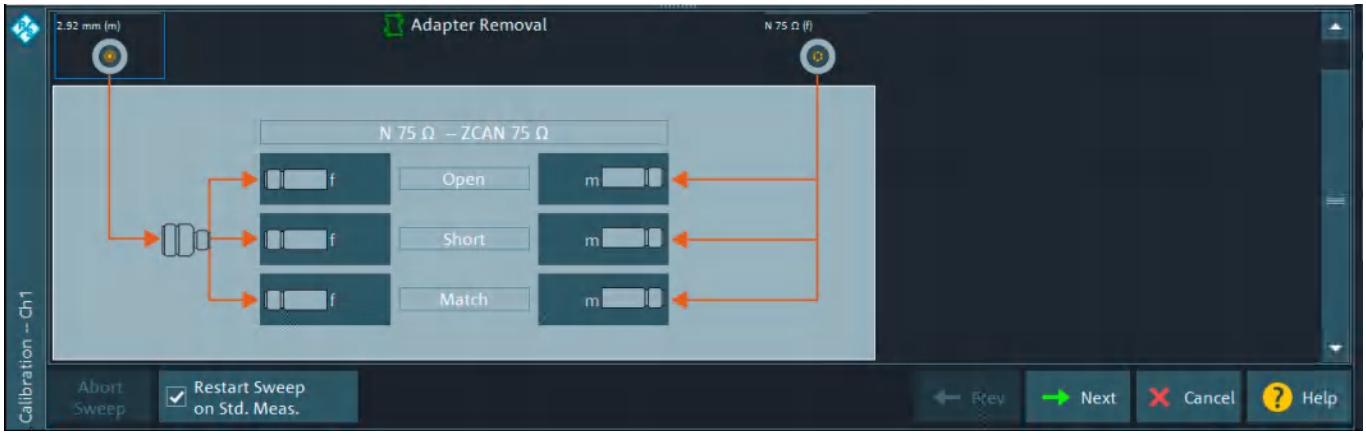
As an alternative, the R&S®ZNA offers classic adapter removal calibration. This method is very robust, but requires considerably more calibration steps.

R&S®SMARTerCal – get ready for active device testing

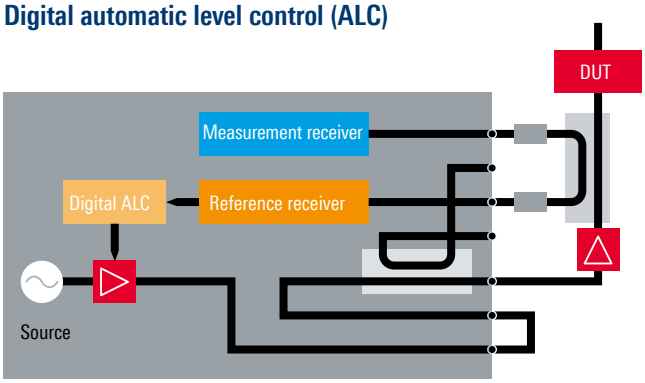
Calibrating the absolute power levels of the sources and receivers is indispensable in order to reliably test amplifiers, mixers and T/R modules. However, this process is time-consuming. The R&S®ZNA uses a special calibration technique referred to as R&S®SMARTerCal, which radically simplifies calibration. R&S®SMARTerCal combines the information gained from system error correction (e.g. TOSM, UOSM) with the information obtained through absolute power level calibration (wave quantities in terms of amplitude and phase). This means that the absolute power levels of the sources and receivers are calibrated already during system error correction, taking into account port mismatch.

For absolute output power level calibration, the power sensor needs to be connected to a test port only once. The calibration values for all other sources and receivers are derived from the calibration values for that specific test port. This significantly reduces calibration time and effort.

Straightforward dialogs guide the user step by step through the adapter removal calibration process for calibrating a DUT with a mix of connectors at the input and output.



Digital automatic level control (ALC)



ALC operation: In the case of a high-power setup with an external preamplifier and a directional coupler, the source power is controlled to match the preamplifier output power. Drift effects can be compensated in this way, making the output power very precise and stable.

Digital automatic level control (ALC)

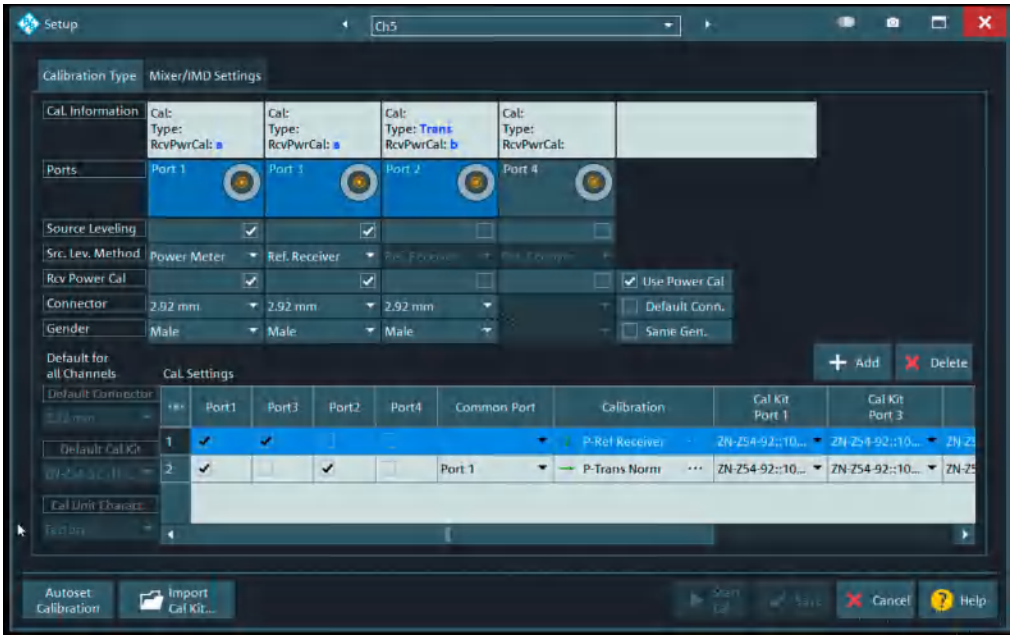
The configurable digital ALC sets the source power precisely to the target value, using a reference signal that can be derived from any point in the test setup. This means that the source power is adjusted, in a minimum of time, to the output power of a preamplifier in the test setup or to the output power of the DUT. Power fluctuations, e.g. due to drift effects, are eliminated. This provides stable, reproducible power conditions over long test cycles.

Unlike wideband diode detectors, the ALC uses the digitally filtered results delivered by the reference receivers. As a result, the source power is adjusted to the power of the wanted signal (fundamental) without any distortion otherwise introduced by harmonics, for example. Users can configure the ALC parameters, such as the ALC IF bandwidth, to achieve the optimum balance of accuracy and control time.

Absolute power level calibration for sources and receivers

To characterize active DUTs and modules such as mixers and amplifiers, it is necessary to calibrate the source output power and the receivers to deliver maximum power measurement accuracy. Absolute power level calibration can be performed for scalar measurements alone (scalar corrected) or in combination with system error correction (port-match corrected) using the R&S®SMARTerCal technique. The parameters for absolute power level calibration can be independently configured on the R&S®ZNA, allowing optimal results to be achieved even for challenging scenarios.

The analyzer's excellent receiver linearity of < 0.05 dB across a wide range from –50 dBm to 0 dBm results in high level accuracy even when measuring very small power levels. The reference and measurement receivers are calibrated at a higher power level that is optimal for the power sensor. The power level is then reduced, while the accuracy of the output power is maintained thanks to the reference receivers' high linearity.



The R&S®SMARTerCal calibration technique combines system error correction with absolute power level correction for sources and receivers.

Fast embedding/deembedding for impedance matching using virtual networks

Coaxial and balanced components, such as surface acoustic wave (SAW) filters used in mobile phone frontends, are specified together with the networks that match them to the impedance of the surrounding circuit. The R&S®ZNA can embed the DUT into virtual matching networks to provide realistic conditions by simulating the DUT installed in its operational environment. The R&S®ZNA offers a choice of predefined matching network topologies. If values of individual network elements are edited, the R&S®ZNA immediately recalculates the network and embeds the DUT in the new network in real time. In addition to predefined topologies, .s2p, .s4p, .s6p and .s8p files can be read into the R&S®ZNA and used for embedding/deembedding.

Enhanced solutions for in-fixture testing

In cooperation with partner companies and integrating complementary third-party tools, the R&S®ZNA was enhanced to offer a variety of in-fixture calibration and expanded (de)embedding functionalities, as well as PCB probing solutions.

PacketMicro smart fixture deembedding (SFD) tool

The smart fixture deembedding (SFD) tool from PacketMicro is simple and accurate, and can be used to extract network parameters for modeling interconnects such as circuit board traces and vias, connectors, IC packages and cables. PacketMicro also offers a wide range of PCB probing solutions that support contacting and testing of small geometry devices. For more information, see www.packetmicro.com.

AtaiTec in-situ deembedding tool

In-situ deembedding (ISD) from AtaiTec is a very accurate, easy-to-handle and inexpensive tool for on-board and in-fixture calibration. For more information, see www.ataitec.com.

Calibration equipment

The R&S®ZN-Z1xx economy calibration kits provide robust operation up to 43.5 GHz. The R&S®ZV-Z2xx/R&S®ZN-Z2xx high-end calibration kits are available for more sophisticated requirements, offering calibration standards from type N through 1.0 mm (110 GHz connectors). These kits achieve very high calibration accuracy thanks to precision manufacturing combined with S-parameter based characterization of the individual calibration standards.

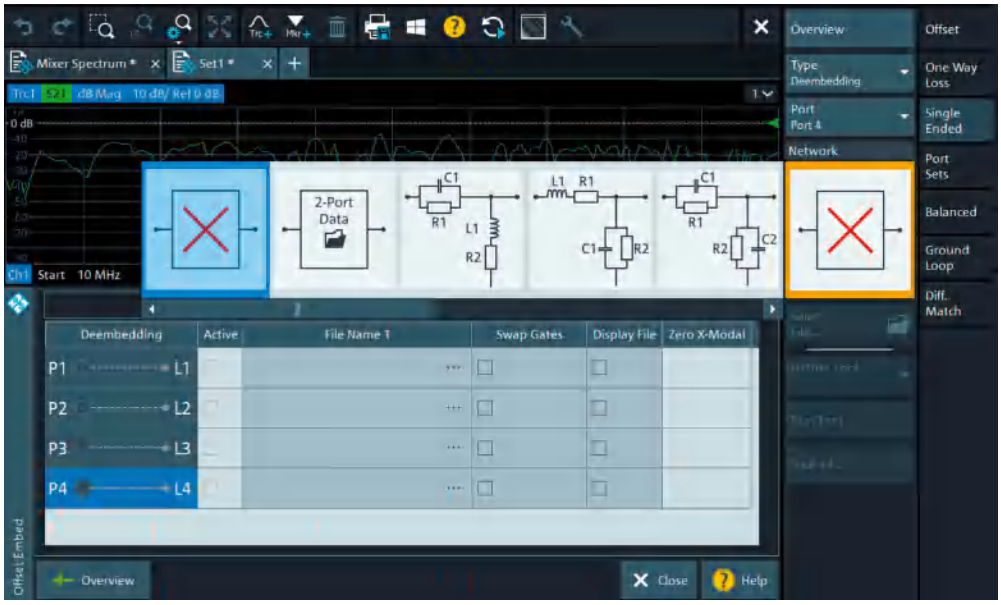
Automatic calibration units

Automatic calibration units up to 67 GHz with two or four ports greatly simplify calibration, while reducing operator errors and improving calibration repeatability.

Calibration of complex setups made easy – the Calibrate All function

Comprehensive characterization of active DUTs, such as amplifiers and converters, usually requires a large number of parameters and settings to be defined. To calibrate a corresponding number of different channels, users need to invest an enormous amount of time and effort. This is aggravated by the risk of operator errors as different calibration standards need to be connected repeatedly. The Calibrate All function in the R&S®ZNA avoids these drawbacks and lets users achieve reliable results with minimum effort. The calibration steps required for

The R&S®ZNA comes with a choice of predefined matching networks whose values can be edited. If values are changed, the R&S®ZNA will immediately recalculate the network and embed the DUT in the new network in real time.



R&S®ZN-Z1xx
economy calibration kit

R&S®ZV-Z210 and R&S®ZV-WR10
high-end calibration kits

R&S®ZV-Z2xx and R&S®ZN-Z2xx
high-end calibration kits

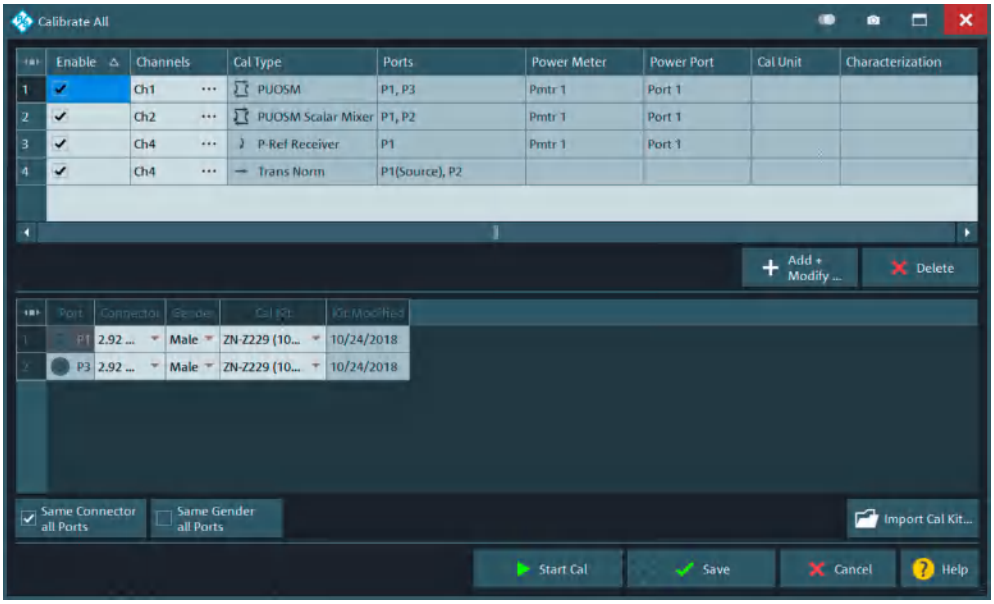
R&S®ZN-Z52
automatic calibration unit

the various channels are combined in the GUI in tabular form, and the firmware processes these steps for an overall calibration procedure covering all channels. Each calibration standard, calibration unit and power sensor needs to be connected only once. All the required data for the currently connected calibration standard/unit/power sensor is collected in the background (e.g. diverse frequency ranges for intermodulation measurements, or different sidebands for converter measurements); no action is required on the part of the user. This drastically reduces the calibration effort for the overall setup.

Results in a minimum of time

Besides very short measurement times, the R&S®ZNA offers other features that significantly speed up data acquisition. The analyzer's high dynamic range of > 129 dB (specified) provides a large signal-to-noise ratio to deliver accurate measurements, even with high IF bandwidths, along with short measurement times. During mixer measurements, RF and IF signals can be measured simultaneously, using the second internal LO source. Compared with other instrument concepts, this yields measurement speed as high as that required for non-frequency-converting S-parameter measurements. The R&S®ZNA can pick up measurement data on all of its ports simultaneously, allowing e.g. a pair of 2-port DUTs to be tested in parallel, thereby doubling the throughput.

The Calibrate All function minimizes the calibration effort for the user. It combines all calibrations for a complete setup and optimizes the calibration process for all channels. Each calibration standard, calibration unit and power sensor needs to be connected only once.



APPLICATIONS

COMPRESSION POINT MEASUREMENTS

Determining the compression point is essential whenever characterizing active components. With the R&S®ZNA, compression point measurements can be flexibly combined with S-parameter measurements.

Forward and reverse power sweeps

In the case of DUTs with high output powers, e.g. on traveling wave tube (TWT) amplifiers, hysteresis effects often occur that affect determination of the compression point. To mitigate these effects, the R&S®ZNA makes it possible to determine the compression point by performing ascending and descending power sweeps.

Power added efficiency (PAE) measurement

Power added efficiency can be measured by connecting an R&S®HMP2030 power supply to the R&S®ZNA. Based on the results delivered by the power supply, the R&S®ZNA measures amplifier efficiency and power consumption as a function of frequency, power and compression.

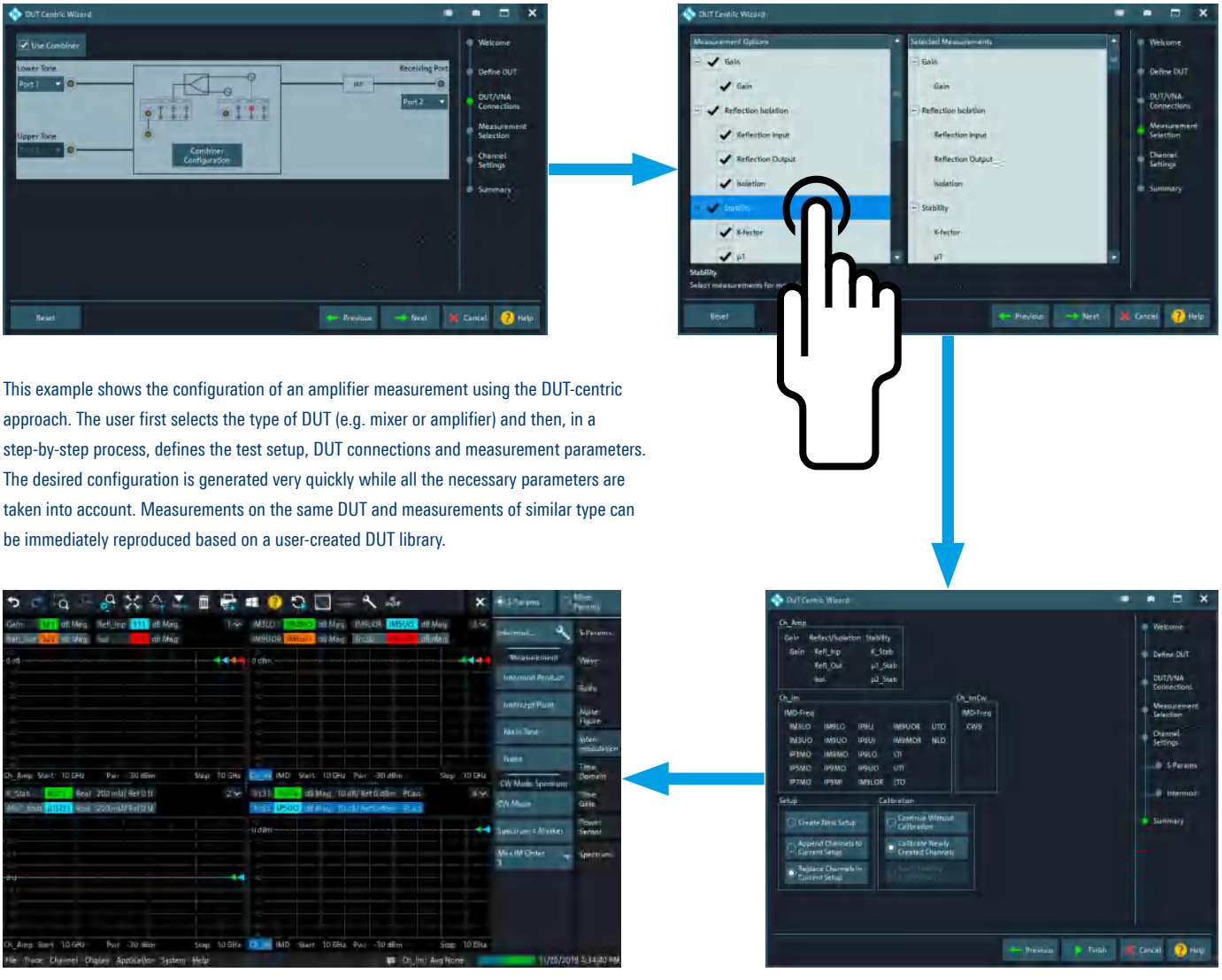
High power measurement accuracy due to vector error correction

Instead of conventional, purely scalar error correction, compression point analysis on the R&S®ZNA relies exclusively on vector error corrected power measurements. This delivers precise results even with poorly matched DUTs.

High measurement speed for frequency-converting DUTs

Using the second LO when measuring frequency-converting DUTs doubles the measurement speed at the same IF bandwidth without increasing trace noise. Measurement time is cut in half without any compromise in accuracy.

DUT-centric measurement configuration

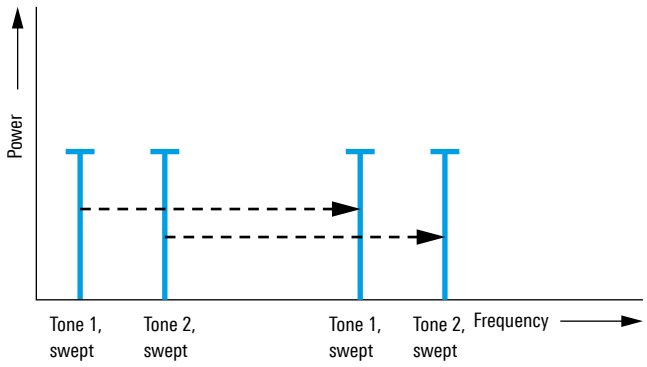


This example shows the configuration of an amplifier measurement using the DUT-centric approach. The user first selects the type of DUT (e.g. mixer or amplifier) and then, in a step-by-step process, defines the test setup, DUT connections and measurement parameters. The desired configuration is generated very quickly while all the necessary parameters are taken into account. Measurements on the same DUT and measurements of similar type can be immediately reproduced based on a user-created DUT library.

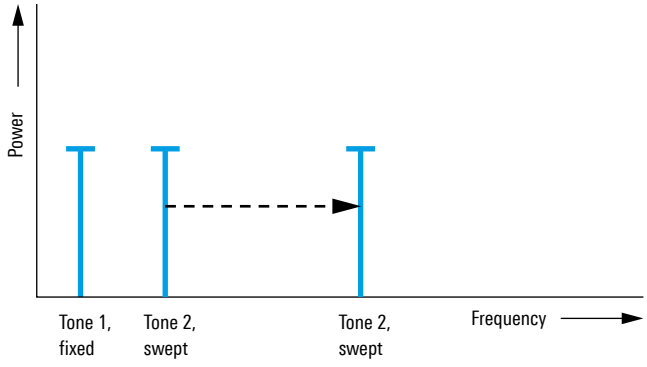
INTERMODULATION MEASUREMENTS ON AMPLIFIERS AND MIXERS

The R&S®ZNA makes it possible to determine the intermodulation characteristics of amplifiers and mixers fast and with high accuracy.

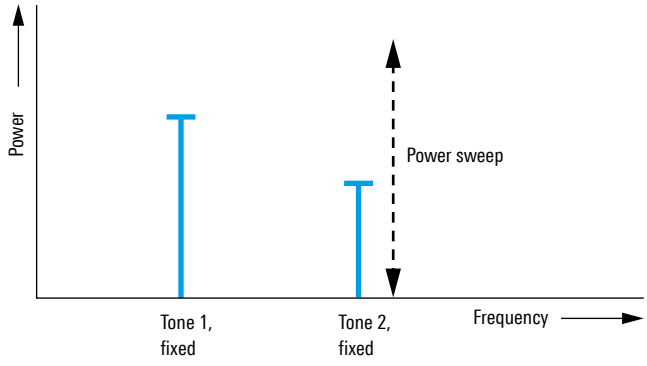
Frequency sweep with fixed carrier spacing



Frequency sweep with variable carrier spacing



Power sweep with fixed carrier spacing



The R&S®ZNA provides the following three types of intermodulation measurements:

- Frequency sweep with fixed carrier spacing
- Frequency sweep with variable carrier spacing
- Power sweep with fixed carrier spacing

Wide dynamic range and digital ALC for challenging intermodulation measurements

The R&S®ZNA offers major benefits especially when measuring amplifiers with very small intermodulation products. Its wide dynamic range and the excellent power handling capacity of its receivers make it possible to measure low intermodulation distortion within seconds instead of minutes.

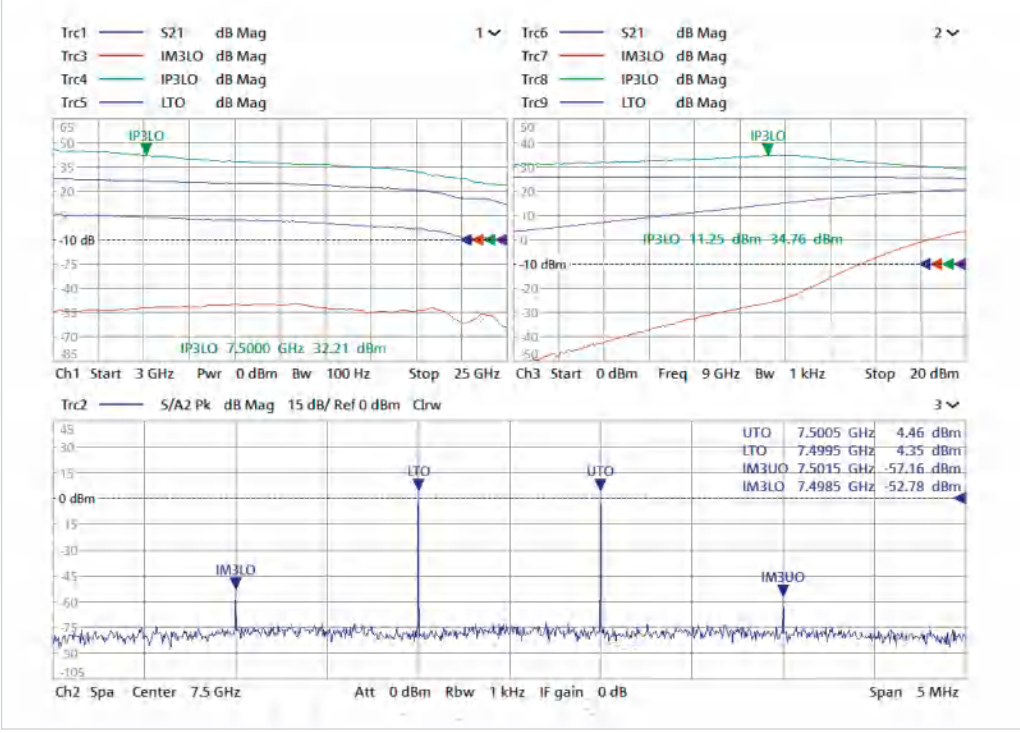
When measuring intermodulation, precise control of the powers applied to the DUT inputs is vital. Here, the R&S®ZNA makes no compromises. Automatic level control (ALC) combined with system error correction ensures a precise amplitude for the individual carriers over the entire frequency range, regardless of the DUT's input reflection coefficient.

High output power and flexibility

Featuring four independent sources, the R&S®ZNA can even perform intermodulation measurements on mixers without requiring an external source. The analyzer delivers high output powers of up to +20 dBm per test port. If this is not sufficient, the R&S®ZNA can flexibly loop external amplifiers into the signal path and precisely control them via ALC.

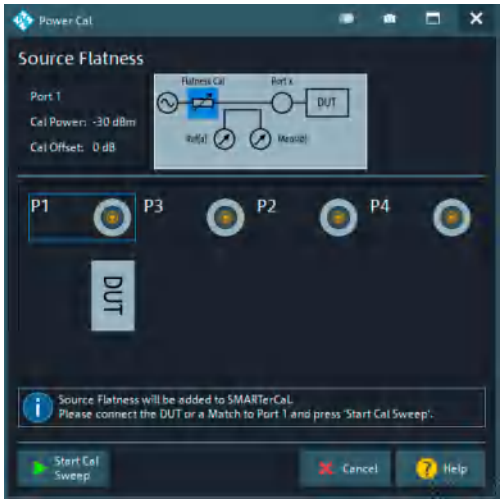
DUT-centric approach simplifies configuration of intermodulation measurements

The DUT-centric approach of the R&S®ZNA supports intuitive navigation for intermodulation measurements. To configure a measurement, the user first selects the type of DUT and is then guided through a dialog to define the test setup, the DUT connections, the measurement quantity or type, e.g. IMx (x = 3, 5, 7, ...) versus frequency, the power at the DUT input and output, or a spectrum measurement. The configuration can be completed by a subsequent, step-by-step user guided calibration procedure.



Comprehensive amplifier characterization, including intermodulation products (IP), IP versus frequency, spectral measurements, and other quantities.

Power calibration GUI for an amplifier intermodulation measurement.



NOISE FIGURE MEASUREMENTS ON AMPLIFIERS AND MIXERS

The R&S®ZNA-K30 noise figure measurements option further enhances the R&S®ZNA to provide a powerful and versatile test system for full characterization of amplifiers and converters.

Noise figure measurements on amplifiers and mixers

The R&S®ZNA-K30 noise figure measurements option expands the R&S®ZNA26 and R&S®ZNA43 [1] to include noise figure analysis for amplifiers, converters and T/R modules. Hardware options can be added to further optimize this functionality, e.g. to stimulate high gain amplifiers with very low levels or to measure low gain/low noise figure LNAs with high accuracy.

Single connection device characterization

Instead of using a noise source to determine the noise figure, the R&S®ZNA directly measures absolute noise power, based on absolute power level calibration and system error correction. Likewise, instrument calibration with a manual calibration standard, a calibration unit or a power sensor requires no extra equipment; an external noise source is not necessary. The calibration process is included in the convenient Calibrate All function for the entire setup. The DUT (amplifier, converter, T/R module) needs to be connected only once to provide full device characterization, including quantities such as (conversion) gain/loss, intermodulation distortion, compression and group delay.

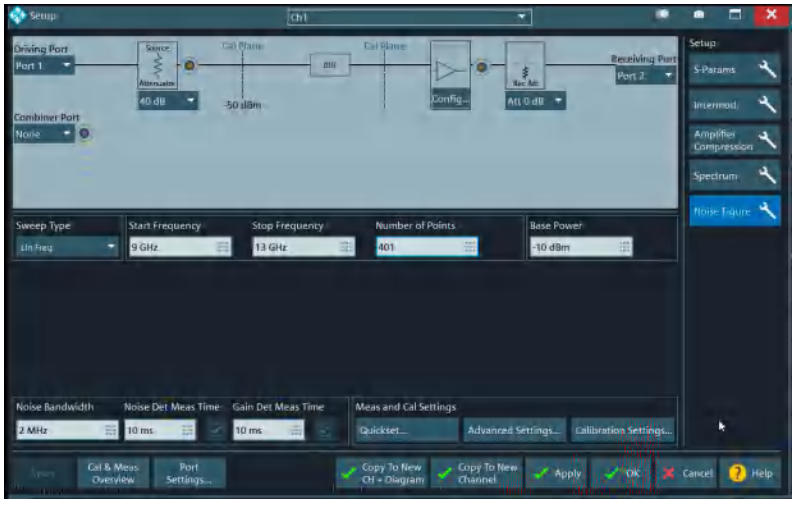
Straightforward main GUI for amplifier and mixer test setups

The GUI shows the hardware components in the measurement path as graphic elements und helps users optimally configure all the details. Users can see all relevant settings at a glance, including source power, step attenuators, the resulting power level at the reference plane, the internal/external preamplifier gain on the receiver side, and the test parameters. The GUI also provides elements for configuring frequency-converting measurements on mixers and converters; even measurements on high gain receivers with embedded LO can be easily configured and deliver reliable results.

Calibration features and settings

The challenge many instruments and devices are facing with this type of measurement is to handle very low stimulus powers and high measured power levels that may even differ for calibration and measurement and in the forward and reverse direction. The main GUI includes essential parameters to help users easily find the desired settings with manual configuration. Correction algorithms such as used in system error correction provide accurate and reliable results.

[1] The R&S®ZNA-K30 noise figure measurements option and complementary hardware options are currently available for the R&S®ZNA26 and R&S®ZNA43 models only.



GUI for configuring noise figure measurements on amplifiers, mixers, converters and T/R modules.

Quickset dialog for interactive and semi-automatic configuration of optimal test parameters and R&S®ZNA hardware.

Quickset – the fast and intuitive way to optimal settings

As an alternative to direct manual configuration of measurement and calibration parameters and the R&S®ZNA hardware, the extremely powerful Quickset dialog guides users interactively to the optimal setup. Based on estimated DUT characteristics such as the approximate noise figure and gain and the desired noise figure (NF) accuracy, the R&S®ZNA calculates parameters such as the measurement time and source power and displays the recommended optimal hardware configuration (e.g. use of direct source monitor access, low-noise preamplifier at receiver port 2 or reverse coupler operation). Interactive graphic elements help the user modify settings. The effects of modifications are calculated and displayed instantaneously and can be assessed by the user. This is a quick way to configure reliable noise figure measurements on amplifiers.

Options supporting noise figure measurements (R&S®ZNA26, R&S®ZNA43)

Designation	Type	Required/recommended	Comment
Noise figure measurements	R&S®ZNA-K30 [1]	required	with R&S®ZNA-K4: support of frequency-converting measurements
Options for source port 1 (3) configuration			
Direct source monitor access, port 1/ports 1 and 3	R&S®ZNAxx-B161/ R&S®ZNAxx-B163 [2]	required	provides a relatively strong reference signal with very low stimulus powers, for low trace noise (requires R&S®ZNAxx-B16/-B21/-B23)
Source step attenuator, port 1/port 3	R&S®ZNAxx-B21/ R&S®ZNAxx-B23	recommended, required with R&S®ZNAxx-B161/-B163	variation of source power
Receiver step attenuator, port 1	R&S®ZNAxx-B31	recommended	power level optimization at measurement receiver
Low-power spurious reduction, port 1	R&S®ZNAxx-B501	recommended	recommended with high gain DUTs (requires R&S®ZNAxx-B31; recommended: R&S®ZNAxx-B21/-B23, R&S®ZNAxx-B16, R&S®ZNAxx-B161/-163)
Options for receiver port 2 configuration			
Low-noise preamplifier, port 2	R&S®ZNAxx-B302	strongly recommended	switchable internal preamplifier, selectable gain steps (requires R&S®ZNAxx-B16, R&S®ZNAxx-B32)
Receiver step attenuator, port 2	R&S®ZNAxx-B32	strongly recommended, required with R&S®ZNAxx-B302	power level optimization at measurement receiver
Direct source and receiver access	R&S®ZNAxx-B16	recommended, required with R&S®ZNAxx-B302	supports reversed coupler operation for increased receiver sensitivity

[1] Installation on R&S®ZNA50 and R&S®ZNA67 models is possible, but dedicated noise figure measurement options are not yet available.
[2] xx designates the R&S®ZNA model (R&S®ZNA26/R&S®ZNA43).

PULSED MEASUREMENTS – FAST AND SIMPLE

The R&S®ZNA offers pulse modulators, pulse generators and synchronization I/Os for analyzing active components under pulsed conditions. Typical DUTs include components and complete T/R modules for radar applications. S-parameters, input and output powers and intermodulation products can be measured without any external components to generate RF pulses and synchronize test sequences.

Internal pulse modulators and pulse generators

The R&S®ZNA can be equipped with one pulse modulator (R&S®ZNAxx-B4n) per port. The pulse modulators can be controlled via external pulse sources or via the four internal pulse generators. The internal pulse generators can also be used to control external pulse modulators via the trigger board outputs. This allows special modulators for very short pulses to be integrated, for example.

Thanks to the test set architecture, once system error calibration has been performed, it remains valid for all types of pulsed measurements – versus frequency, power and time – even if the pulse duty cycle is changed. The R&S®ZNA digital section is designed so that users can configure the pulse parameters individually for each port, supported by a convenient GUI. In addition to double pulses, users can configure arbitrary pulse sequences (i.e. with arbitrary start and stop times for all pulses) in a clearly laid out table.

Measurements versus frequency and power

The R&S®ZNA supports the common measurement techniques for pulsed applications such as point-in-pulse and pulse profile measurements. For average pulse measurements, which rely on narrow IF bandwidths, the R&S®ZNA offers highly selective IF digital filters for the carrier signal.

Point-in-pulse measurements

Short sampling times of 32 ns are achieved for point-in-pulse measurements with IF bandwidths ranging up to 30 MHz. In addition to S-parameters, the absolute peak power can be determined in amplitude and intermodulation measurements. Flexible trigger functions support complex pulsed measurement scenarios and facilitate synchronization of measurements.

Pulse profile analysis versus time with 8 ns resolution

Equipped with the R&S®ZNA-K7 option (measurements on pulsed signals), the R&S®ZNA supports pulse profile measurements with a time resolution of 8 ns. This technique is suitable for periodic, non-periodic and one-shot pulse scenarios.

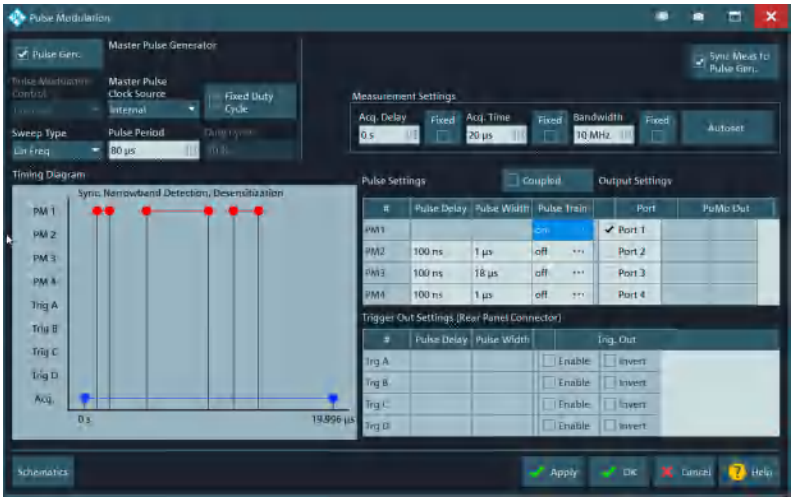
The analyzer provides simultaneous measurement of a signal on multiple receivers and for multiple wave quantities. The maximum number of wave quantities depends on the IF bandwidth and can vary e.g. between two (at 30 MHz IF bandwidth) and eight (at 1 MHz IF bandwidth). The number of wave quantities can be doubled using the R&S®ZNA-B7 data streaming memory option.

Pulsed measurements

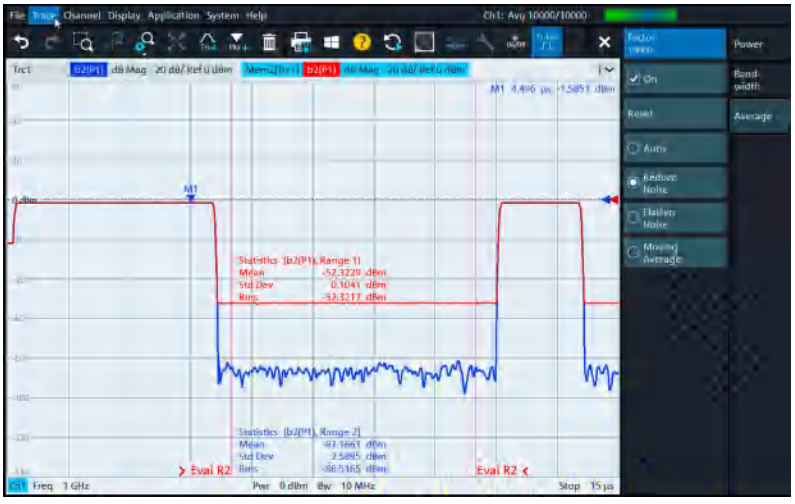
	Functions	Options
Hardware	► Four internal pulse generators with 4 ns time resolution and 8 ns minimum pulse width ► One pulse modulator per port with 40 ns minimum pulse width ► Four trigger inputs ► Four trigger outputs	The internal pulse generators are enabled with one of the following options: R&S®ZNA-B91 (trigger and control I/O board) or R&S®ZNAxx-B4n (internal pulse modulator, port n). The R&S®ZNA-B7 (data streaming memory) increases the number of wave quantities that can be measured in parallel with the R&S®ZNA-K7 (measurements on pulsed signals).
Pulse profile measurements	► Up to 30 MHz IF bandwidth ► 8 ns time resolution ► 40 ns minimum pulse width	R&S®ZNA-K7 (measurements on pulsed signals)
Point-in-pulse measurements	40 ns minimum pulse width (30 MHz IF bandwidth)	R&S®ZNA-K17 (increased IF bandwidth 30 MHz)

Wideband pulsed measurements with high dynamic range

With up to 30 MHz IF bandwidth, the R&S®ZNA provides point-in-pulse and pulse profile measurements on very short pulses. At the same time, the analyzer offers techniques to deliver extremely low-noise traces or achieve a very high dynamic range despite the wide measurement bandwidth. Unique in the R&S®ZNA is a method for averaging complex values, which allows sensitivity in the order of –90 dBm to be achieved at an IF bandwidth of 10 MHz, for example.



Configuration of parameters for pulsed signal measurements.



Pulse profile measurement:
The wideband measurement mode enables single-shot pulse sweeps without averaging. Averaging (AVG) modes are also available to achieve either very low trace noise or a very high dynamic range (i.e. a high pulse on/off ratio) based on vector averaging.
Red trace: AVG mode "Flatten noise".
Blue trace: AVG mode "Reduce noise".

Pulse profile measurement with arbitrary pulse sequences. Pulse sequences can be measured on multiple receivers simultaneously. Since the receivers are phase coherent, they not only measure the amplitude of a pulse but also its phase with high stability. This allows the phase deviation of a DUT to be determined very simply and reliably.

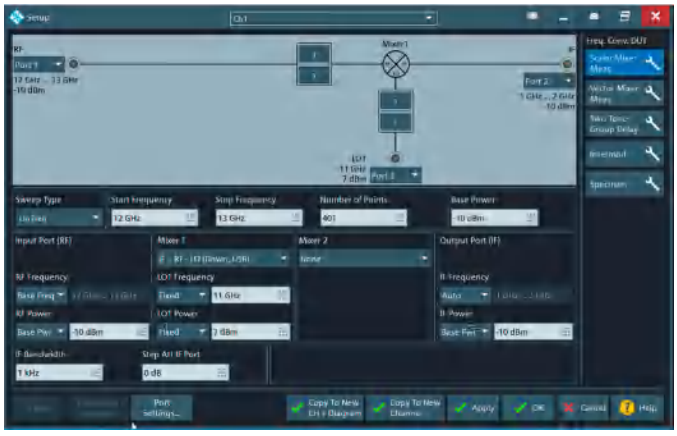
MIXER MEASUREMENTS EASIER THAN EVER

Fast setup and short measurement times with four internal sources and two internal LOs

The R&S®ZNA 4-port model comes with up to four internal sources. Swept LO measurements and intermodulation measurements versus frequency on mixers are performed up to ten times faster compared to setups that use external sources.

Conventional conversion loss measurements with a network analyzer require two measurement steps: first, the RF input power is measured and then the IF output power. With two independent LOs for the internal receivers, the R&S®ZNA can perform both measurements simultaneously, delivering measurement speed twice as fast as with just one LO while reducing trace noise during conversion loss and group delay measurements.

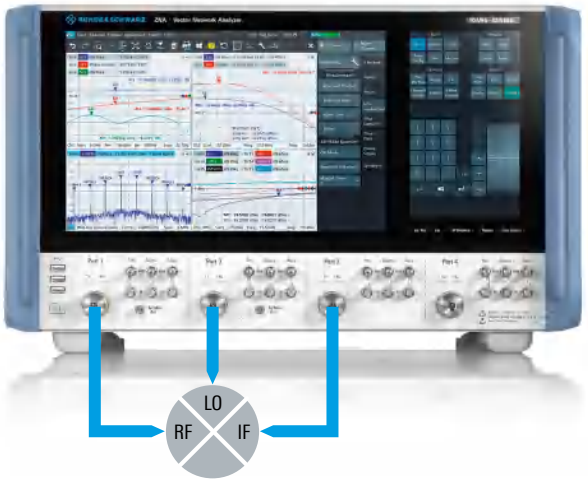
DUT-centric configuration of mixer measurements.



High accuracy and easy configuration thanks to R&S®SMARTerCal

The R&S®ZNA determines the return loss and scalar conversion loss of mixers and converters with high precision using R&S®SMARTerCal, a special calibration technique that combines system error correction with absolute power level calibration. It corrects mismatch of the test ports and mixer; no attenuators are needed to improve port matching. Port match correction also ensures accurate results when using the R&S®ZNA-K9 option (group delay measurements on frequency converters without LO access).

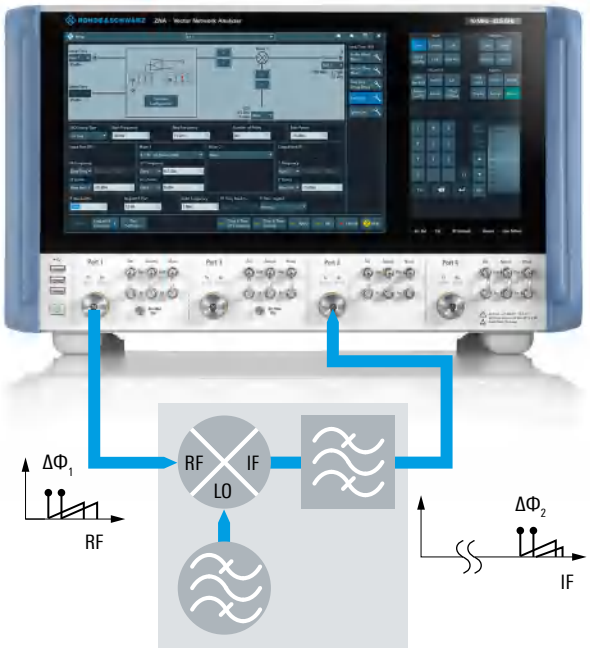
Phase measurement on a mixer



R&S®ZN-Z5x automatic calibration unit

R&S®ZN-ZM292 calibration mixer

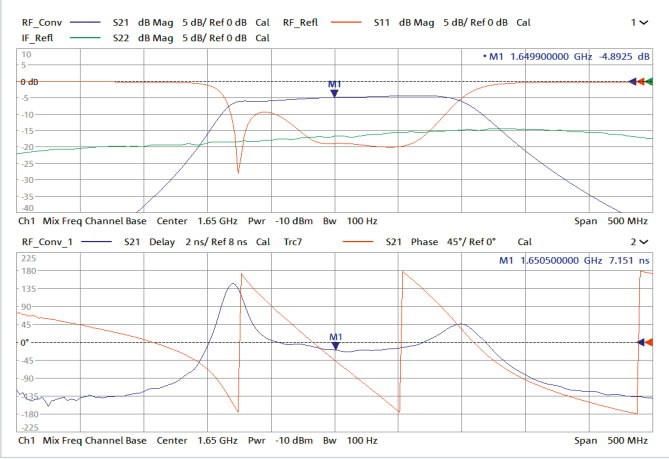
Group delay measurement on a converter with two-tone signal applied to the mixer



Two-tone signal obtained with R&S®ZNAxx-B213 internal combiner or an external combiner.

Unique approach for phase and group delay measurements on converters without LO access

The R&S®ZNA offers a special technique for measuring group delay and relative phase on frequency converters in cases where there is no access to the internal LO or the reference frequency. The analyzer uses a two-tone signal to stimulate the DUT. From the phase difference between the carriers at the input and output, the instrument calculates the group delay and the relative phase. The frequency drift and frequency modulation of the DUT's internal LO do not affect the measurement accuracy as long as the frequency deviation lies within the analyzer's IF bandwidth used for the measurement.



Results of a converter measurement including return loss, conversion loss, phase and group delay.

Relative phase measurements on frequency converters using vector error correction

Any receiving system requires a flat amplitude and phase response in order to transmit information smoothly and without disruptions. With the R&S®ZNA-K5 option (vector corrected converter measurements), the R&S®ZNA determines the magnitude and phase for the transmission parameters of mixers and converters with LO access. This measurement uses the phase coherent, phase repeatable synthesizers in the R&S®ZNA in combination with a 2-port power UOSM (PUOSM) calibration. The measurement itself does not require a reference mixer for frequency back-conversion. However, a calibration mixer such as the R&S®ZN-ZM292 can be used as an unknown through for calibration. The measurement is quick and easy to configure. It delivers the magnitude and phase for all four system error corrected S-parameters of a frequency converter, as well as its phase and group delay and AM/AM and AM/PM conversion.

Frequency-converting measurements

Type of measurement	Functions	Options
Scalar mixer and arbitrary frequency-converting measurements	► Conversion loss of mixers ► 2nd source for swept LO measurements ► 3rd and 4th internal source for intermodulation measurements on mixers and receivers with two converter stages ► R&S®SMARTerCal for vector error corrected scalar frequency-converting measurements ► Correction of mismatch on test ports ► Scalar conversion loss and return loss ► Isolation measurement: LO → RF and LO → IF ► Intermodulation products and nth-order intercept point ► AM/AM conversion	R&S®ZNA-K4, R&S®ZNAxx-B3n
	► 2nd internal LO source for twice the measurement speed ► Rear panel output for internal LO signal as the 5th source (when 2nd internal LO source (R&S®ZNA-B5, up to 26.5 GHz) is installed, the 2nd LO source is made available at the output)	R&S®ZNA-B5, R&S®ZNA-B8
Vector error corrected converter measurements	► 2-port power UOSM (PUOSM) calibration for vector error corrected conversion loss measurements ► Forward and reverse conversion loss (magnitude and phase) ► Absolute/relative group delay ► AM/AM and AM/PM conversion	R&S®ZNA-K5
	► Calibration mixer	R&S®ZN-ZM292
Measurements on frequency converters without LO access	► Group delay and relative phase ► 2nd internal LO for twice the measurement speed and for low trace noise	R&S®ZNA-K9, R&S®ZNA-B5

SPECTRUM ANALYSIS WITH MULTICHANNEL VIEW

The R&S®ZNA-K1 spectrum analysis function provides a deeper insight into a DUT's behavior where S-parameter measurements versus frequency and power are not sufficient.

The FFT-based spectrum analysis function can be used to measure a DUT's spurious and harmonics, providing short sweep times along with high dynamic range and fine frequency resolution. It quickly detects undesired signal components (spurious) in converters and T/R modules. The marker-to-spectrum function directly gets to the root of problems in the event of unexpected S-parameter results, thus providing fast and extremely useful integrated diagnostics.

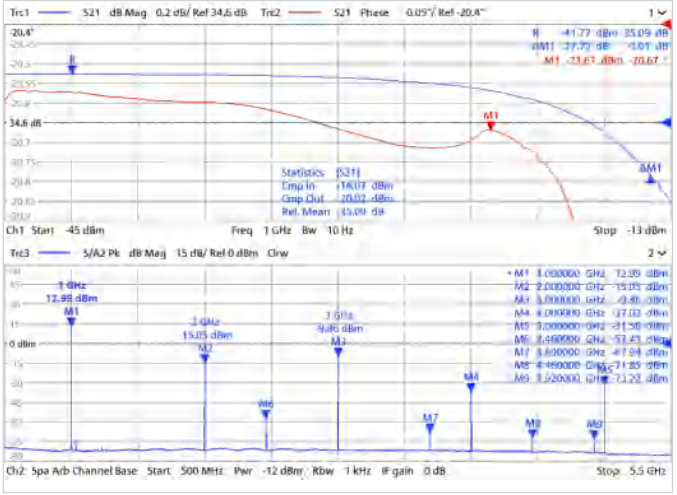
Multichannel view of mixer measurements with harmonic and spurious search

The spectrum analysis function is available on all ports of the R&S®ZNA. It relies on scalar system error correction, boosting accuracy and eliminating the influences of the test setup. In multichannel view, multiple results are displayed simultaneously. For example, an S-parameter measurement can be displayed along with the harmonics spectrum, or the conversion loss along with the spurious signals for a mixer.

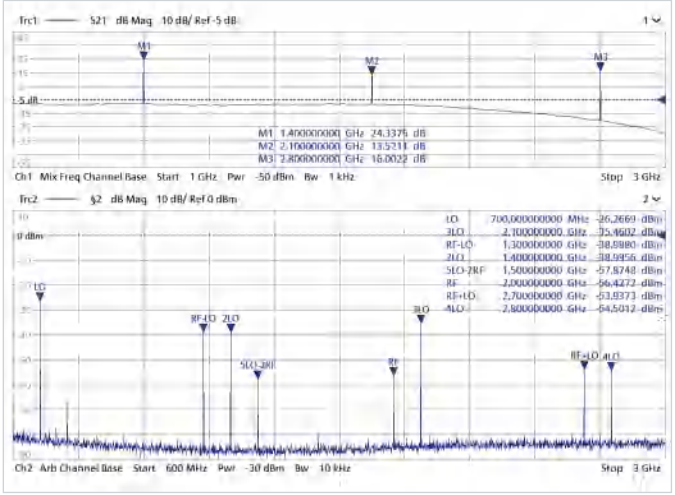
Combined S-parameter and spectrum analysis with marker function

When undesired effects are detected during S-parameter measurements, the root cause of the problem can be identified with a subsequent spectrum analysis, which is performed at the press of a button. A marker is placed on the desired frequency, and spectrum analysis around this frequency will deliver conclusive information about unwanted effects. In addition, a noise marker can be used to display the normalized noise power in dBm (1 Hz).

R&S®ZNA-K1 spectrum analyzer option: amplifier magnitude and phase compression measurement (at 1 GHz, top), and corresponding harmonic and spurious spectrum.



R&S®ZNA-K1 spectrum analyzer option: output spectrum of a mixer.



TIME DOMAIN ANALYSIS AND SIGNAL INTEGRITY MEASUREMENTS

Efficient time domain analysis with enhanced resolution

The R&S®ZNA offers powerful time domain analysis to measure components such as test fixtures, cables and connectors in the frequency and time domain. With up to 100 000 points per trace, the R&S®ZNA can easily measure even electrically long DUTs such as cables. Using the gating function, the analyzer can locate discontinuities and analyze them in detail.

A 4-port R&S®ZNA can be used to determine the balanced S-parameters and other quantities such as near-end and far-end crosstalk (NEXT, FEXT) on two-wire lines and differential structures. Using prediction, the frequency range of the R&S®ZNA can be virtually extended. This yields temporal and spatial resolution substantially higher than would be expected from the DUT's and/or analyzer's frequency range.

Distance-to-fault measurements

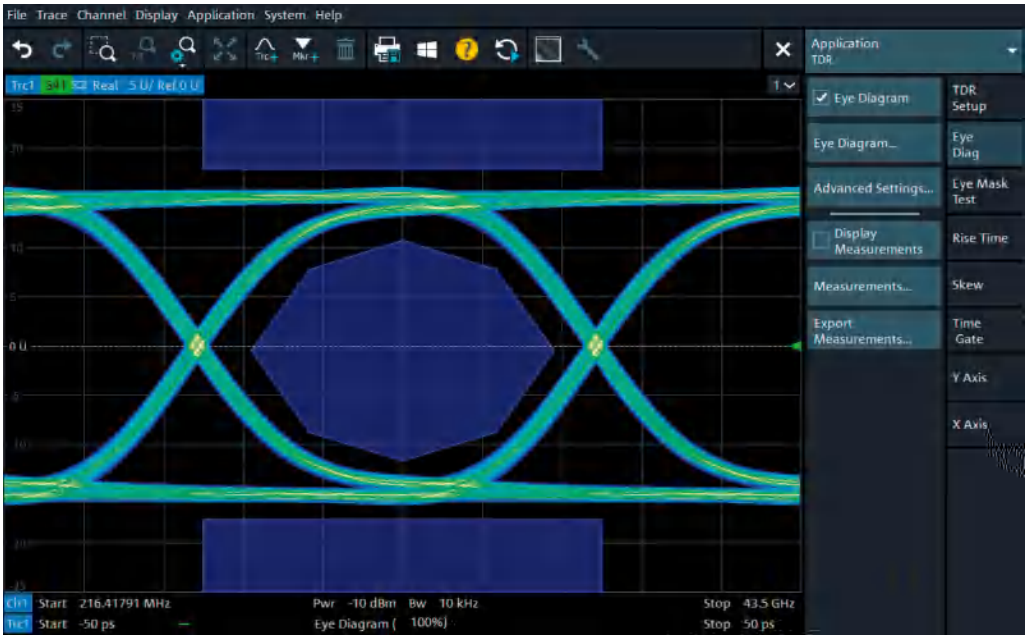
The R&S®ZNA-K2 time domain analysis option has a special menu for the straightforward configuration of distance-to-fault (DTF) measurements. Discontinuities in transmission lines are directly measured and displayed versus distance using S-parameter reflection measurements.

Signal integrity at a glance with eye diagrams

Verifying the quality of a transmission path usually requires testing all of its components. The R&S®ZNA provides comprehensive analysis of cables and connectors in the time and frequency domain. The R&S®ZNA-K20 extended time domain analysis option makes it possible to compute, based on the S-parameters, the rise time, skew and eye diagrams for different bit patterns. The R&S®ZNA-K2 time domain analysis and R&S®ZNA-K20 extended time domain analysis options are integrated into the analyzer firmware. Eye diagrams and S-parameters versus frequency and time can be analyzed and displayed simultaneously, revealing the transmission quality at a glance.

Analysis of disturbance effects and signal quality optimization

The R&S®ZNA-K20 extended time domain analysis option makes it possible to simulate the effects of disturbances such as jitter and noise on the eye diagram. The analyzer can also simulate the impact of correction algorithms, e.g. for predistortion at the transmitter end and for equalization at the receiver end. Plus, the R&S®ZNA-K20 option can be used to configure user-defined mask tests. These tests make it possible to verify compliance of the DUT's behavior with relevant standards such as USB, HDMI™ and DVI.



The R&S®ZNA-K20 option offers versatile signal integrity measurements, e.g. eye diagrams with a mask to verify compliance with relevant requirements. It can also be used to determine the transmission characteristics of signals with jitter or noise.

ANTENNA MEASUREMENTS – THE PERFECT FIT

With its wide range of hardware and software functions, the R&S®ZNA can be used as the high-performing core in near-field, far-field, compact range and radar cross section (RCS) antenna test systems.

The outstanding receiver sensitivity of the R&S®ZNA, in combination with fast synthesizers, speeds up antenna characterization even when measuring very low signal levels. The analyzer's high sensitivity, low trace noise, wide range of selectable IF bandwidths and various averaging functions help to find the optimum balance of short test times and high accuracy.

For test systems employing external mixers, the R&S®ZNA allows flexible, independent configuration of the frequencies and powers for all sources and receivers, as well as direct IF signal path access with selectable IF frequencies.

The R&S®ZNA can provide stimulus signals from up to four sources, making it possible to measure the directional pattern of electronically controlled antenna arrays.

In addition, the internal LO signal (standard LO or second internal LO source up to 26.5 GHz) is accessible on the rear panel. This means that up to five sources are available for feeding antenna arrays or for external up/downconversion.

Featuring a true parallel receiver architecture with up to eight receivers, the analyzer reliably measures the amplitude and phase of up to eight input signals.

Benefits of the R&S®ZNA in antenna measurements

Functions/characteristics	Benefits
High receiver sensitivity up to –151 dBm (1 Hz) (typ., with direct receiver access)	Short measurement times
Inputs for direct access to IF signal paths, selectable IF frequencies with 1 GHz bandwidth	Use in high-frequency test systems with external mixers Adaptation to optimal IF of test system
Identical RF design of all receivers	Identical characteristics of measurement and reference channels
Up to 5 internal sources [1)]	► Multi-antenna stimulation ► LO signals for extenal mixers
Configuration of arbitrary frequency-converting measurements	Universal support for external mixers and mmWave systems
Reverse frequency sweep	► Alternating movement of positioner (CW, CCW in azimuth, plus movement in elevation) ► Spherical near-field measurements
Extended trigger functionality	► Optimal synchronization of positioner, clock generators, etc. ► Simple and flexible system integration
Truly parallel receiver architecture	► Measurements with up to eight receivers (no multiplexing) ► Simultaneous measurements of multiple antenna polarizations (horizontal/vertical) and antenna arrays (MIMO)
mmWave converters	Measurements in mmWave range

[1)] Up to four RF sources plus LO source (on rear panel output, 2nd internal LO source up to 26.5 GHz).

The R&S®ZNA can therefore be used as a compact multichannel receiver to design antenna arrays and subarrays for MIMO mobile communications systems, or it can be used as part of antenna test systems employing horizontally and/or vertically polarized antennas as well as reference receiving antennas.

The R&S®ZNA can perform RCS measurements and measurements on complete RX modules without any external test equipment. With up to four signal sources, up to four internal pulse modulators and generators, up to eight true receivers, and the ability to sample up to 16 wave quantities in parallel, the R&S®ZNA provides signal generation and multichannel measurements in a single, compact platform (see also "Pulsed measurements – fast and simple", page 36).

The R&S®ZNA forms the powerful core in antenna test systems.

mmWave MEASUREMENTS

Frequency bands in the mmWave and terahertz ranges are used in many applications in the mobile communications, automotive, security, semiconductor and fundamental research sectors. Automotive radar at 77 GHz/79 GHz, mobile communications in the 5G frequency bands, and radars and sensors up to and beyond 100 GHz all require the characterization of active and passive components such as filters, amplifiers, mixers and antennas.

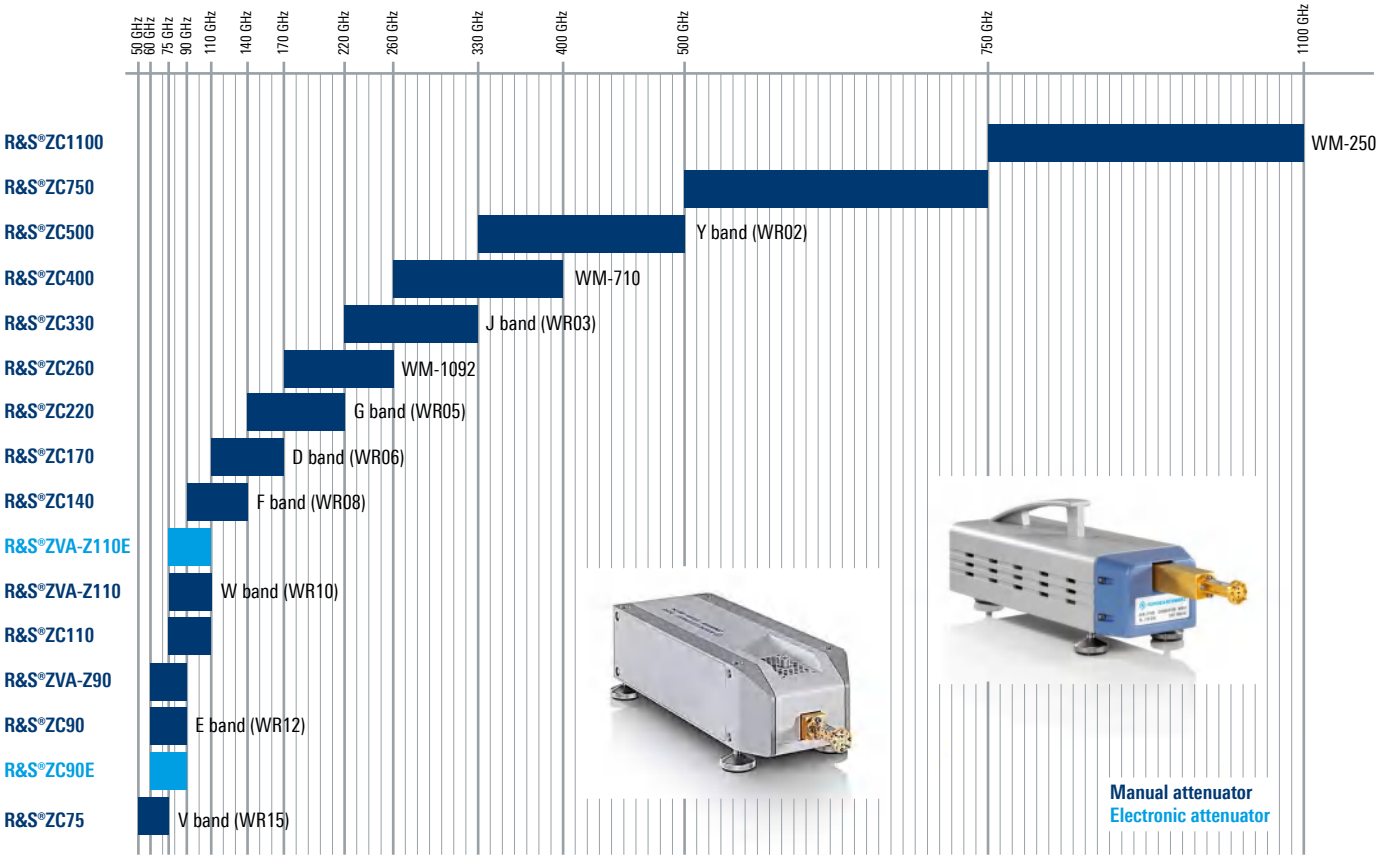
Frequency extension into the terahertz range

The R&S®ZVA-Zxxx and R&S®ZCxxx mmWave converters extend the R&S®ZNA frequency range up to 1.1 THz. Many applications, in particular on-wafer component characterization and antenna measurements, call for high output powers of the frequency converters. The high operating frequencies of the components under test lead to significant losses in waveguides, probe tips and along the transmission path. The Rohde&Schwarz frequency converters feature high output powers and excellent dynamic range. They can be used to characterize active and passive DUTs.

Compact systems with dedicated options

The optional R&S®ZNA-B8 mmWave converter LO output makes the analyzer's internal LO signal available at the rear panel. The signal comes from the standard LO or, when a second internal LO is installed, from the 2nd LO. It provides up to +25 dBm output power, which is sufficient to feed up to four frequency converters connected to the R&S®ZNA. Configuration of the R&S®ZNA-B8 output for use with mmWave converters requires the R&S®ZNA-K8 option (mmWave converter support). The output power is automatically calibrated to compensate for any losses introduced by cables and splitters. With the R&S®ZNA-B26 direct IF access option installed, the converters' measurement and reference signals are directly fed to the analyzer's IF path. The R&S®ZNAxx-B16 direct source and receiver access option can be used alternatively.

Overview of R&S®ZCxxx mmWave converters

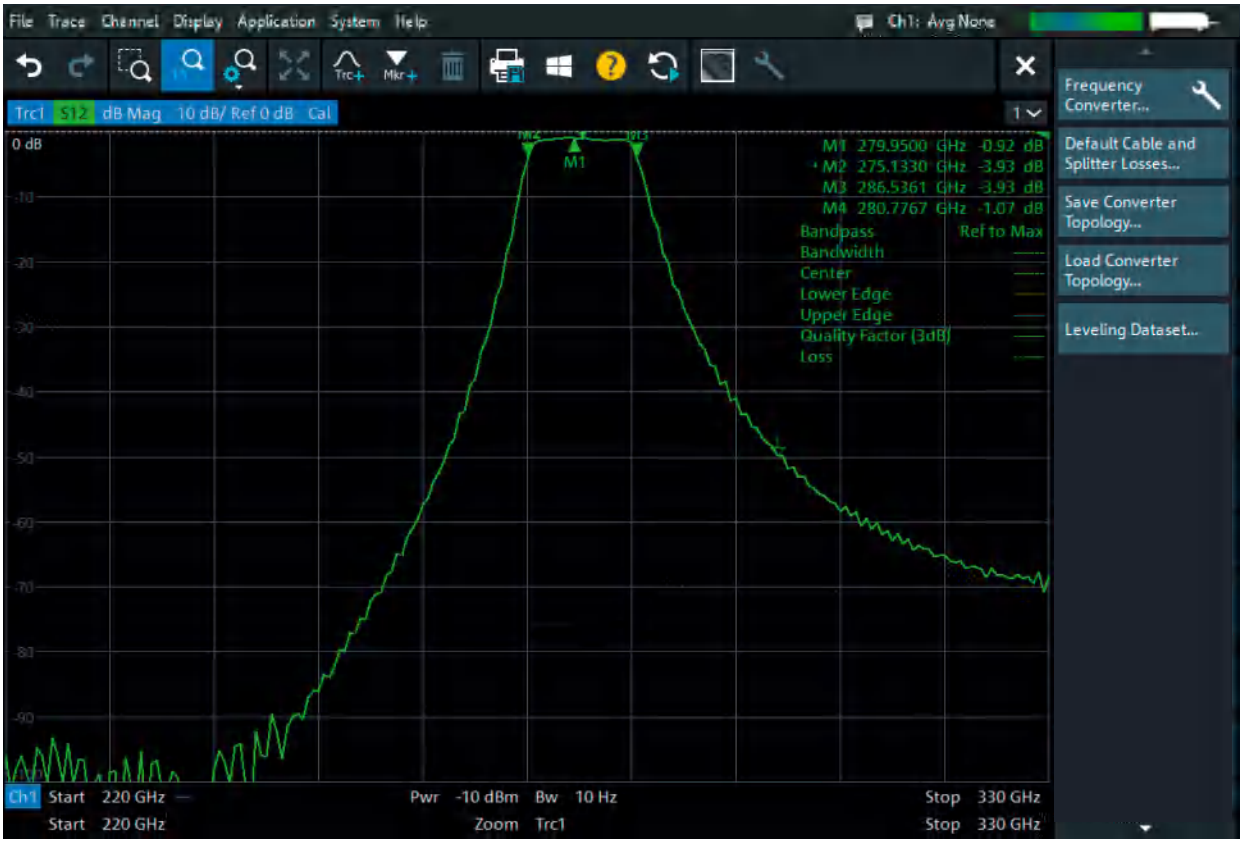


Special features of R&S®ZVA-Zxxx and R&S®ZCxxx mmWave converters

- High output powers and wide dynamic range
- Easy configuration via straightforward dialog
- Multiport measurements with up to four converters without an external source
- Variable output power (manual adjustment with screw and/or control of output power by varying the input power)
- Amplifier characterization, power sweeps, compression point measurements
- Pulsed measurements
- On-wafer component characterization, integration into MPI Corporation and FormFactor (formerly Cascade Microtech) wafer prober systems
- Waveguide calibration kits (with or without sliding match) for all frequency bands of the converters
- High time and temperature stability
- Frequency-converting measurements [1)]

[1)] Converters with different frequency ranges can be used; external source(s) may be required, depending on setup/configuration.

2-port measurement in WM-864 band (220 GHz to 330 GHz) with an R&S®ZNA43 and two R&S®ZC330 mmWave converters WM-864.



Setup for mmWave measurements with an R&S®ZNA43 and two R&S®ZC330 mmWave converters WM-864.

Software configuration

- Straightforward dialog for configuring 1-port to 4-port mmWave converter setups
- Menu-based selection of R&S®ZVA-Zxxx converter(s); automatic detection of R&S®ZCxxx converter(s)
- Configuration of customer's mmWave converters
- Support of Rohde&Schwarz and Erickson power sensors for absolute power level calibration up to 750 GHz
- Configuration of frequency-converting measurements [1)]

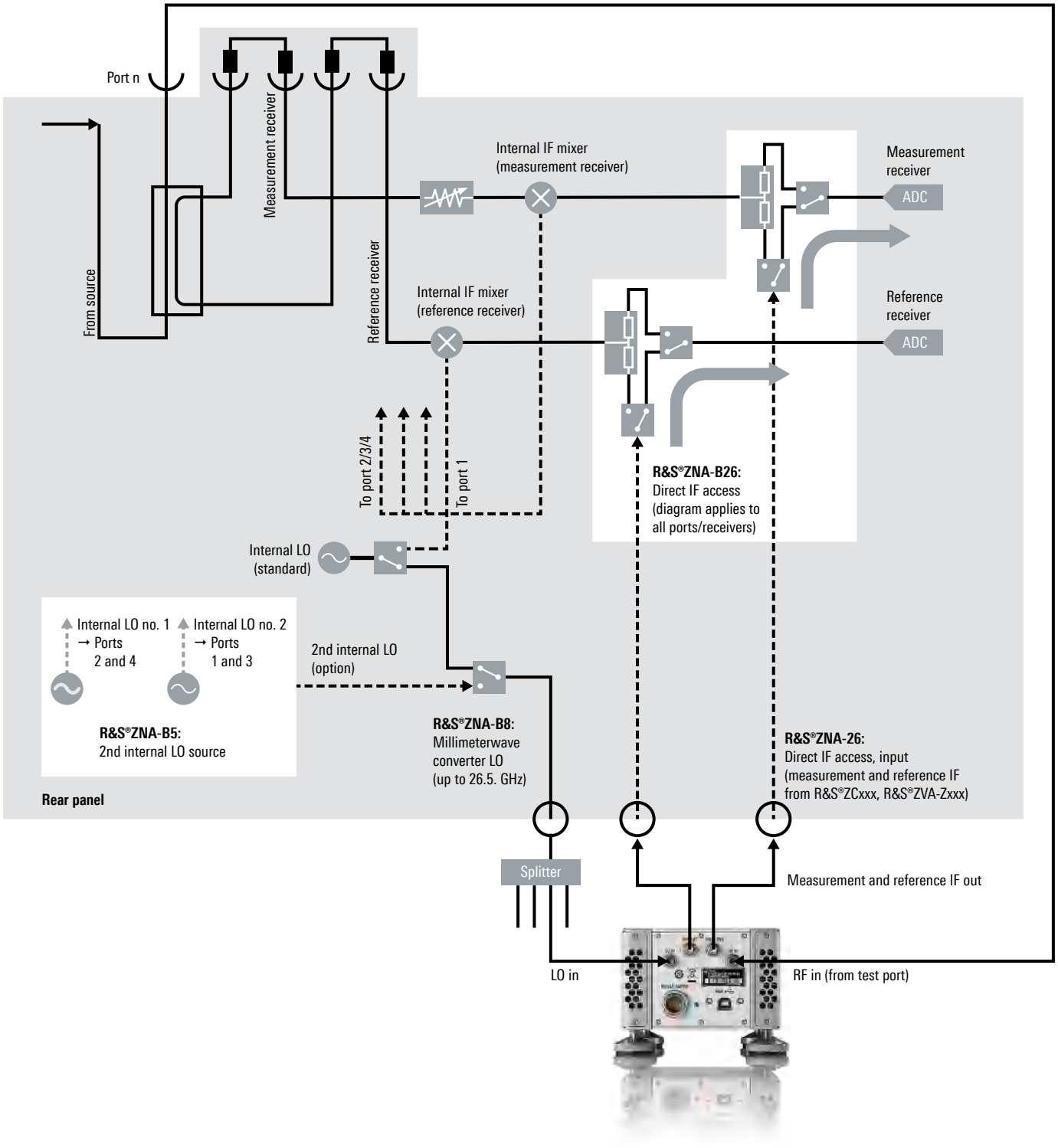
[1)] Converters with different frequency ranges can be used; external source(s) may be required, depending on setup/configuration.

Software configuration.

Hardware configuration

- Rear panel LO output up to +25 dBm (R&S®ZNA-B8 mmWave converter LO option) reliably provides converters with desired power even with long cables and LO splitters
- Use of direct IF inputs on R&S®ZNA rear panel
- Direct IF inputs with 1 GHz bandwidth for flexible integration of customer's mmWave converters
- Compact test setups: 2/4-port mmWave converter setups with 2/4-port R&S®ZNA, no external source or adapter box required

Hardware configuration for mmWave measurements



ORDERING INFORMATION

Designation	Type	Frequency range	Order No.
Base units			
Vector network analyzer, 2 ports, 26.5 GHz, 3.5 mm connectors	R&S®ZNA26	10 MHz to 26.5 GHz	1332.4500.22
Vector network analyzer, 4 ports, 26.5 GHz, 3.5 mm connectors	R&S®ZNA26	10 MHz to 26.5 GHz	1332.4500.24
Vector network analyzer, 2 ports, 43.5 GHz, 2.92 mm connectors	R&S®ZNA43	10 MHz to 43.5 GHz	1332.4500.42
Vector network analyzer, 2 ports, 43.5 GHz, 2.4 mm connectors	R&S®ZNA43	10 MHz to 43.5 GHz	1332.4500.43
Vector network analyzer, 4 ports, 43.5 GHz, 2.92 mm connectors	R&S®ZNA43	10 MHz to 43.5 GHz	1332.4500.44
Vector network analyzer, 4 ports, 43.5 GHz, 2.4 mm connectors	R&S®ZNA43	10 MHz to 43.5 GHz	1332.4500.45
Vector network analyzer, 2 ports, 50 GHz, 2.4 mm connectors	R&S®ZNA50	10 MHz to 50 GHz	1332.4500.52
Vector network analyzer, 4 ports, 50 GHz, 2.4 mm connectors	R&S®ZNA50	10 MHz to 50 GHz	1332.4500.54
Vector network analyzer, 2 ports, 67 GHz, 1.85 mm connectors	R&S®ZNA67	10 MHz to 67 GHz	1332.4500.62
Vector network analyzer, 4 ports, 67 GHz, 1.85 mm connectors	R&S®ZNA67	10 MHz to 67 GHz	1332.4500.64
Options			
Direct source and receiver access, for R&S®ZNA26 (2 ports)	R&S®ZNA26-B16	100 kHz to 26.5 GHz	1332.4581.22
Direct source and receiver access, for R&S®ZNA26 (4 ports)	R&S®ZNA26-B16	100 kHz to 26.5 GHz	1332.4581.24
Direct source and receiver access, for R&S®ZNA43 (2 ports)	R&S®ZNA43-B16	100 kHz to 43.5 GHz	1332.4581.42
Direct source and receiver access, for R&S®ZNA43 (4 ports)	R&S®ZNA43-B16	100 kHz to 43.5 GHz	1332.4581.44
Direct source and receiver access, for R&S®ZNA50 (2 ports)	R&S®ZNA50-B16	10 MHz to 50 GHz	1332.6278.52
Direct source and receiver access, for R&S®ZNA50 (4 ports)	R&S®ZNA50-B16	10 MHz to 50 GHz	1332.6278.54
Direct source and receiver access, for R&S®ZNA67 (2 ports)	R&S®ZNA67-B16	10 MHz to 67 GHz	1332.6278.62
Direct source and receiver access, for R&S®ZNA67 (4 ports)	R&S®ZNA67-B16	10 MHz to 67 GHz	1332.6278.64
Source step attenuator, port n, for R&S®ZNA26 [1]	R&S®ZNA26-B2n	10 MHz to 26.5 GHz	1332.4630.2n
Source step attenuator, port n, for R&S®ZNA43 [1]	R&S®ZNA43-B2n	10 MHz to 43.5 GHz	1332.4646.2n
Source step attenuator, port n, for R&S®ZNA50 [1]	R&S®ZNA50-B2n	10 MHz to 50 GHz	1332.5188.2n
Source step attenuator, port n, for R&S®ZNA67 [1]	R&S®ZNA67-B2n	10 MHz to 67 GHz	1332.5194.2n
Receiver step attenuator, port n, for R&S®ZNA26 [1]	R&S®ZNA26-B3n	10 MHz to 26.5 GHz	1332.4700.3n
Receiver step attenuator, port n, for R&S®ZNA43 [1]	R&S®ZNA43-B3n	10 MHz to 43.5 GHz	1332.4717.3n
Receiver step attenuator, port n, for R&S®ZNA50 [1]	R&S®ZNA50-B3n	10 MHz to 50 GHz	1332.5165.3n
Receiver step attenuator, port n, for R&S®ZNA67 [1]	R&S®ZNA67-B3n	10 MHz to 67 GHz	1332.5171.3n
Internal pulse modulator, port n, for R&S®ZNA26 [1]	R&S®ZNA26-B4n	10 MHz to 26.5 GHz	1332.4775.4n
Internal pulse modulator, port n, for R&S®ZNA43 [1]	R&S®ZNA43-B4n	10 MHz to 43.5 GHz	1332.4781.4n
Internal pulse modulator, port n, for R&S®ZNA50 [1]	R&S®ZNA50-B4n	10 MHz to 50 GHz	1332.5088.4n
Internal pulse modulator, port n, for R&S®ZNA67 [1]	R&S®ZNA67-B4n	10 MHz to 67 GHz	1332.5094.4n
3rd and 4th internal source, for R&S®ZNA26 (4 ports)	R&S®ZNA26-B3	10 MHz to 26.5 GHz	1332.4523.02
3rd and 4th internal source, for R&S®ZNA43 (4 ports)	R&S®ZNA43-B3	10 MHz to 43.5 GHz	1332.4617.02
3rd and 4th internal source, for R&S®ZNA50 (4 ports)	R&S®ZNA50-B3	10 MHz to 50 GHz	1332.4981.02
3rd and 4th internal source, for R&S®ZNA50 (4 ports)	R&S®ZNA67-B3	10 MHz to 67 GHz	1332.4998.02
Direct source monitor access, port 1, for R&S®ZNA26 [2]	R&S®ZNA26-B161	10 MHz to 26.5 GHz	1332.4823.51
Direct source monitor access, port 1 and port 3, for R&S®ZNA26 [2]	R&S®ZNA26-B163	10 MHz to 26.5 GHz	1332.4823.53
Direct source monitor access, port 1, for R&S®ZNA43 [2]	R&S®ZNA43-B161	10 MHz to 43.5 GHz	1332.4303.51
Direct source monitor access, port 1 and port 3, for R&S®ZNA43 [2]	R&S®ZNA43-B163	10 MHz to 43.5 GHz	1332.4830.53
Low-noise preamplifier at receiver, port 2, for R&S®ZNA26 [3]	R&S®ZNA26-B302	10 MHz to 26.5 GHz	1332.4752.12
Low-noise preamplifier at receiver, port 2, for R&S®ZNA43 [3]	R&S®ZNA43-B302	10 MHz to 43 GHz	1332.4769.12
Low-power spurious reduction, port 1, for R&S®ZNA26 [4]	R&S®ZNA26-B501	10 MHz to 26.5 GHz	1332.5220.11
Low-power spurious reduction, port 1, for R&S®ZNA43 [4]	R&S®ZNA43-B501	10 MHz to 43.5 GHz	1332.5236.11
Internal combiner, port 1 and port 3 [5]	R&S®ZNA26-B213	10 MHz to 26.5 GHz	1332.4846.13
Internal combiner, port 1 and port 3 [5]	R&S®ZNA43-B213	10 MHz to 43.5 GHz	1332.4869.13

[1] n designates the port number (1/2/3/4).

[2] R&S®ZNAxx-B161: 2-port and 4-port R&S®ZNA, requires R&S®ZNAxx-B16, R&S®ZNAxx-B21;
R&S®ZNAxx-B163: 4-port R&S®ZNA, requires R&S®ZNAxx-B16, R&S®ZNAxx-B21, R&S®ZNAxx-B23.
xx designates the R&S®ZNA model (R&S®ZNA26/R&S®ZNA43).

[3] Requires R&S®ZNA26-B32/R&S®ZNA43-B32 and R&S®ZNA26-B16/R&S®ZNA43-B16.

[4] Requires R&S®ZNA26-B31/R&S®ZNA43-B31, R&S®ZNA26-B16/R&S®ZNA43-B16 and R&S®ZNA26-B16x/R&S®ZNA43-B16x.

[5] 4-port R&S®ZNA only. Requires R&S®ZNAxx-B21 and R&S®ZNAxx-B23.

Designation	Type	Frequency range	Order No.
Precision frequency reference (OCXO)	R&S®ZNA-B4		1332.4530.02
2nd internal LO source for R&S®ZNA (4 ports)	R&S®ZNA-B5		1332.4675.02
Data streaming memory	R&S®ZNA-B7		1332.4546.02
Millimeterwave converter LO	R&S®ZNA-B8	10 MHz to 26.5 GHz	1332.4652.02
RFFE GPIO interface	R&S®ZNA-B15		1332.4575.02
RFFE GPIO interface, including voltage/current measurement	R&S®ZNA-B15		1332.4575.03
Direct IF access	R&S®ZNA-B26		1332.4598.02
Trigger and control I/O board	R&S®ZNA-B91		1332.4800.02
Spectrum analyzer mode	R&S®ZNA-K1		1332.5320.02
Time domain analysis (TDR)	R&S®ZNA-K2		1332.5336.02
Extended time domain analysis (including eye diagram) [6]	R&S®ZNA-K20		1332.4746.02
Scalar mixer and arbitrary frequency-converting measurements	R&S®ZNA-K4		1332.5342.02
Vector corrected converter measurements (without reference mixer and phase reference) [7]	R&S®ZNA-K5		1332.5359.02
Phase coherent source control	R&S®ZNA-K6		1332.5413.02
True differential mode	R&S®ZNA-K61		1332.5442.02
Measurements on pulsed signals [8]	R&S®ZNA-K7		1332.5371.02
Increased IF bandwidth 30 MHz	R&S®ZNA-K17		1332.5459.02
Millimeterwave converter support	R&S®ZNA-K8		1332.5388.02
Group delay measurements on frequency converters without LO access [9]	R&S®ZNA-K9		1332.5394.02
1 mHz frequency resolution	R&S®ZNA-K19		1332.5513.02
Noise figure measurements	R&S®ZNA-K30		1332.5465.02
Uncertainty analysis	R&S®ZNA-K50		1332.5542.02
Uncertainty analysis, preinstalled	R&S®ZNA-K50P		1332.5594.02
Security write protection	R&S®ZNA-K51		1332.5559.02
Data streaming memory [10]	R&S®ZNA-B7		1332.4546.02
Easy deembedding	R&S®ZNA-K210		1339.3897.02
In-situ deembedding	R&S®ZNA-K220		1339.3900.02
Smart fixture deembedding	R&S®ZNA-K230		1339.3916.02
Delta-L PCB characterization	R&S®ZNA-K231		1339.3922.02
mmWave converters [11]			
Converter WR15 (one module)	R&S®ZVA-Z75	50 GHz to 75 GHz	1307.7400.02
Converter WR12 (one module)	R&S®ZVA-Z90	60 GHz to 90 GHz	1322.3024.02
Converter WR10 (one module)	R&S®ZVA-Z110	75 GHz to 110 GHz	1307.7000.03
Converter WR10 (one module)	R&S®ZVA-Z110E	75 GHz to 110 GHz	1307.7000.40
Converter WG 3.6 mm × 1.8 mm (one module)	R&S®ZC78	53.57 GHz to 78.33 GHz	3626.5356.02
Converter WR12 (one module)	R&S®ZC90	60 GHz to 90 GHz	1323.7600.02
Converter WR12 (one module)	R&S®ZC90E	60 GHz to 90 GHz	1323.7600.04
Converter WM-2540 (one module)	R&S®ZC110	75 GHz to 110 GHz	1323.7617.02
Converter WM-2032 (one module)	R&S®ZC140	90 GHz to 140 GHz	1323.7623.02
Converter WM-1651 (one module)	R&S®ZC170	110 GHz to 170 GHz	1323.7630.02
Converter WM-1295 (one module)	R&S®ZC220	140 GHz to 220 GHz	1323.7646.02
Converter WM-1092 (one module)	R&S®ZC260	170 GHz to 260 GHz	3628.5682.02
Converter WM-864 (one module)	R&S®ZC330	220 GHz to 330 GHz	1323.7669.02
Converter WM-570 (one module)	R&S®ZC500	330 GHz to 500 GHz	1323.7681.02
Converter WM-750 (one module)	R&S®ZC750	500 GHz to 750 GHz	1323.7717.02
Converter WM-250 (one module)	R&S®ZC1100	750 GHz to 1100 GHz	1323.7723.02

[6] Requires R&S®ZNA-K2.
[7] Requires R&S®ZNA-K4.
[8] Requires R&S®ZNA-K17.
[9] Requires R&S®ZNA-K4, R&S®ZNAxx-B16, and an R&S®ZNAxx-Z9 cable set, or R&S®ZNA-B213 internal combiner, for generating a two-tone signal. An R&S®ZNA (4 ports) is strongly recommended.
[10] Increases the number of receivers that can be used in parallel for pulse profile measurements (depending on IF bandwidth).
[11] Converters require R&S®ZNA-K8.

Designation	Type	Frequency range	Order No.
Calibration and verification			
Calibration kits (manual calibration)			
Calibration kit, 3.5 mm, 50 Ω	R&S®ZN-Z235	0 Hz to 26.5 GHz	1336.8500.02
Calibration kit, 2.92 mm, 50 Ω	R&S®ZN-Z229	0 Hz to 43.5 GHz	1336.7004.02
Calibration kit, 2.4 mm, 50 Ω	R&S®ZN-Z224	0 Hz to 50 GHz	1339.5002.02
Calibration kit, 1.85 mm, 50 Ω	R&S®ZN-Z218	0 Hz to 67 GHz	1337.3502.02
Calibration kit, 1.0 mm, 50 Ω	R&S®ZV-Z210	0 Hz to 110 GHz	5011.6588.02
Waveguide calibration kits			
Waveguide calibration kit WR15 (without sliding match)	R&S®ZV-WR15	50 GHz to 75 GHz	1307.7500.30
Waveguide calibration kit WR15 (with sliding match)	R&S®ZV-WR15	50 GHz to 75 GHz	1307.7500.31
Waveguide calibration kit WR12 (without sliding match)	R&S®ZV-WR12	60 GHz to 90 GHz	1307.7700.10
Waveguide calibration kit WR12 (with sliding match)	R&S®ZV-WR12	60 GHz to 90 GHz	1307.7700.11
Waveguide calibration kit WR10 (without sliding match)	R&S®ZV-WR10	75 GHz to 110 GHz	1307.7100.10
Waveguide calibration kit WR10 (with sliding match)	R&S®ZV-WR10	75 GHz to 110 GHz	1307.7100.11
Waveguide calibration kit WR08 (without sliding match)	R&S®ZV-WR08	90 GHz to 140 GHz	1307.7900.10
Waveguide calibration kit WR08 (with sliding match)	R&S®ZV-WR08	90 GHz to 140 GHz	1307.7900.11
Waveguide calibration kit WR06 (without sliding match)	R&S®ZV-WR06	110 GHz to 170 GHz	1311.8807.10
Waveguide calibration kit WR06 (with sliding match)	R&S®ZV-WR06	110 GHz to 170 GHz	1311.8807.11
Waveguide calibration kit WR05 (without sliding match)	R&S®ZV-WR05	140 GHz to 220 GHz	1307.8106.10
Waveguide calibration kit WR05 (with sliding match)	R&S®ZV-WR05	140 GHz to 220 GHz	1307.8106.11
Waveguide calibration kit WR03 (without sliding match)	R&S®ZV-WR03	220 GHz to 325 GHz	1307.7300.30
Waveguide calibration kit WR03 (with sliding match)	R&S®ZV-WR03	220 GHz to 325 GHz	1307.7300.31
Waveguide calibration kit WR02 (without sliding match)	R&S®ZV-WR02	325 GHz to 500 GHz	1314.5550.10
Waveguide calibration kit WM-1092	R&S®ZCWM-1092	170 GHz to 260 GHz	3628.5699.02
Waveguide calibration kit WM-710	R&S®ZCWM-710	260 GHz to 400 GHz	1339.4070.02
Waveguide calibration kit WM-570	R&S®ZCWM-570	330 GHz to 500 GHz	1322.3099.10
Waveguide calibration kit WM-380	R&S®ZCWM-380	500 GHz to 750 GHz	1322.3101.02
Waveguide calibration kit WM-250	R&S®ZCWM-250	750 GHz to 1100 GHz	1322.3118.02
Calibration units (automatic calibration)			
Calibration unit, 2 ports, 3.5 mm (f)	R&S®ZN-Z50	9 kHz to 26.5 GHz	1335.6904.32
Calibration unit, 4 ports, 3.5 mm (f)	R&S®ZN-Z52	100 kHz to 26.5 GHz	1335.6991.30
Calibration unit, 2 ports, 3.5 mm (f)	R&S®ZN-Z53	100 kHz to 26.5 GHz	1335.7046.32
Calibration unit, 2 ports, 2.92 mm (f)	R&S®ZN-Z54	9 kHz to 43.5 GHz	1335.7117.92
Calibration unit, 2 ports, 2.4 mm (f)	R&S®ZN-Z55	9 kHz to 50 GHz	1335.7181.42
Calibration unit, 2 ports, 1.85 mm (f)	R&S®ZN-Z156	5 GHz to 67 GHz	1332.7239.02
Inline calibration units (automatic calibration)			
Inline calibration unit controller	R&S®ZN-Z30		1328.7609.02
Inline calibration unit, 40 GHz	R&S®ZN-Z33		1328.7644.02
Inline calibration unit, 40 GHz TVAC	R&S®ZN-Z33		1328.7644.03
Verification kits			
T-check verification device, 3.5 mm (f to m)	R&S®ZV-Z335	45 MHz to 26.5 GHz	1319.1018.02
T-check verification device, 2.92 mm (f to m)	R&S®ZV-Z329	45 MHz to 40 GHz	1319.1024.02
T-check verification device, 2.4 mm (f to m)	R&S®ZV-Z324	45 MHz to 50 GHz	1319.1030.02
Verification kit, 3.5 mm	R&S®ZV-Z435	45 MHz to 26.5 GHz	1319.1060.02
Verification kit, 2.92 mm	R&S®ZV-Z429	45 MHz to 40 GHz	1319.1076.02
Verification kit, 2.4 mm	R&S®ZV-Z424	45 MHz to 50 GHz	1319.1082.02
Test cables			
3.5 mm (f) to 3.5 mm (m), length: 0.6 m/1 m	R&S®ZV-Z93	0 Hz to 26.5 GHz	1301.7595.25/38
2.92 mm (f) to 2.92 mm (m), length: 0.6 m/1 m	R&S®ZV-Z95	0 Hz to 40 GHz	1301.7608.25/38
2.4 mm (f) to 2.4 mm (m), length: 0.6 m	R&S®ZV-Z97	0 Hz to 50 GHz	1301.7637.25
3.5 mm (f) to 3.5 mm (m), length: 0.6 m/0.9 m/1.5 m	R&S®ZV-Z193	0 Hz to 26.5 GHz	1306.4520.24/36/60
2.92 mm (f) to 2.92 mm (m), length: 0.6 m/0.9 m	R&S®ZV-Z195	0 Hz to 40 GHz	1306.4536.24/36
1.85 mm (f) to 1.85 mm (m), length: 0.6 m/0.9 m	R&S®ZV-Z196	0 Hz to 67 GHz	1306.4559.24/36

Designation	Type	Frequency range	Order No.
Hardware add-ons			
Calibration mixer, 2.92 mm (f)	R&S®ZN-ZM292	10 MHz to 40 GHz	1339.3800.02
Torque wrench for 3.5/2.92/2.4/1.85 mm connector, 8 mm width, 0.9 Nm torque	R&S®ZN-ZTW		1328.8534.35
Torque wrench for R&S®ZNA test port connector, 19 mm width, 0.9 Nm torque	R&S®ZN-ZTW		1328.8534.19
Additional removable hard disk	R&S®ZNA-B19		1332.4600.02
19" rack adapter	R&S®ZZA-KN6		1175.3056.00
Cable set for R&S®ZNA-K9 (3.5 mm for R&S®ZNA26) [12]	R&S®ZNA26-Z9		1332.4730.26
Cable set for R&S®ZNA-K9 (2.92 mm for R&S®ZNA43) [12]	R&S®ZNA43-Z9		1332.4730.43
Cable set for R&S®ZNA-K9 (2.4 mm for R&S®ZNA43) [12]	R&S®ZNA43-Z9		1332.4730.44
Cable set for R&S®ZNA K9 (1.85 mm for R&S®ZNA50) [12]	R&S®ZNA50-Z9		1332.4730.50
Cable set for R&S®ZNA K9 (1.85 mm for R&S®ZNA67) [12]	R&S®ZNA67-Z9		1332.4730.67

Hardware upgrade options

Hardware options can be retrofitted either with a B option (R&S®ZNA-Bx/-Bxx, R&S®ZNAxx-Bx/-Bxx/-Bxxx) or with a U (upgrade) option. U options are required for the following upgrades:

- Direct source monitor access: R&S®ZNAxx-U161/R&S®ZNAxx-B163.
  These options additionally require R&S®ZNAxx-U16 and R&S®ZNAxx-U21/R&S®ZNAxx-U23, unless the corresponding B options (R&S®ZNAxx-B16, R&S®ZNAxx-B21/R&S®ZNAxx-B23) are already installed.
- All source and receiver step attenuators: R&S®ZNAxx-U2n, R&S®ZNAxx-U3x

For further information, contact your local Rohde&Schwarz sales office.

Warranty		
Base unit		3 years
All other items [13]		1 year
Options		
Extended warranty, one year	R&S®WE1	Please contact your local Rohde&Schwarz sales office.
Extended warranty, two years	R&S®WE2	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	
Extended warranty with accredited calibration coverage, one year	R&S®AW1	
Extended warranty with accredited calibration coverage, two years	R&S®AW2	

Your local Rohde&Schwarz expert will help you determine the optimum solution for your requirements.
To find your nearest Rohde&Schwarz representative, visit www.sales.rohde-schwarz.com

[12] Cable set to combine the signals from port 1 and port 3 of an R&S®ZNA (4 ports) to produce a two-tone signal. Required for intermodulation measurements and embedded LO group delay measurements with R&S®ZNA-K9 option.
[13] For options that are installed, the remaining base unit warranty applies if longer than 1 year. Exception: All batteries have a 1 year warranty.

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